

The Effects of Sequencing and Producing Narrative Components of a Story on
Reading Comprehension

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Abstract

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In three experiments, I tested for the presence of the naming capability, the participants' drawing responses of the stimuli learned in the absence of the visual stimulus, and the participants' comprehension of texts with and without pictures present. In Experiment 1, I tested for the presence of naming and the drawing responses for the stimuli presented during the naming experience in the absence of the visual stimulus in 44 third and fourth grade participants. Results demonstrated that fewer instances of the naming capability, as well as the drawing response, were seen in students performing below grade-level in reading, than students performing on or above grade-level. I hypothesized that differences in reading performance may be due to the absence of a strong production response repertoire, which include behaviors such as drawing and speaking. Experiment 2 assessed whether or not the presence of visual stimuli during reading has an effect on the target participants' comprehension of a story, as well as if the presence of the speaker component of naming and the drawing responses had an effect on comprehension. Results demonstrated that there were significant differences in comprehension scores between the three groups during the with pictures condition $\chi^2(2, N=44) = 24.38, p = 0.00$ and the without pictures condition $\chi^2(2, N=44) = 33.47, p = 0.00$. Furthermore, there was a significant correlation between mean comprehension scores and the number of components drawn correctly $\rho(44) = .412, p = .005$. These results are consistent with the theory that the visualization of events and characters in a story is necessary to facilitate

reading comprehension. Experiment 3 employed a multiple probe design across 3 groups of 2 participants to test the effects of sequencing and producing narrative components of a story on the participants' responses to comprehension questions for texts without pictures present. The participants were 6 third grade students who demonstrated below-grade-level comprehension skills for texts without pictures present. Prior to the intervention, all participants exhibited lower comprehension scores for texts without pictures present than for texts with pictures present. Following the intervention, all participants' comprehension scores for texts without pictures present increased, and 5 of the 6 participants showed increases in comprehension for texts with pictures present as well. Furthermore, following the intervention all participants demonstrated increases in the conditioned seeing repertoire, with 4 of the 6 participants meeting criterion level responding.

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DEDICATION

Carl J. Mercorella

The way you lived your life demonstrated that facing adversity is not an excuse to give up, but rather an opportunity to prove what you are capable of.

Chapter I

Review of the Literature

Predictors of Academic Success

In education today, reading is regarded as an essential repertoire for academic success. The basis of reading instruction starting in kindergarten is focused on teaching children to decode words, and by fourth grade shifts to having students read to learn information (Annie E. Casey Foundation, 2010). From fourth grade forward, being literate is a skill necessary for access to the general education curriculum and the relevant information needed to be successful in an educational setting. Meaning that students are not only required to read in order to learn concepts across various disciplines such as mathematics, science, and social studies; but also, disseminate and apply the information accessed to situations in the environment (Annie E. Casey Foundation, 2010). Due to this methodological shift in instruction, many students are unable to independently access the curriculum in fourth grade as a result of not having mastered the foundational reading skills necessary for this higher-level application (Annie E. Casey Foundation, 2010). These missing foundational reading skills render up to half of the printed fourth grade curriculum incomprehensible to students reading below grade-level (Annie E. Casey Foundation, 2010). This fact has repercussions for students reading below grade-level at the end of third grade.

A longitudinal study conducted by Lesnick, Goerge, Smithgall, & Gwynne (2010) established that a child's third grade reading level is a significant predictor of future educational performance. Lesnick et al (2010) followed 26,015 first time third-grade

students in Chicago Public schools from third grade until the end of high school. The researchers aimed to assess the relationship between third grade reading level and future educational milestones including: 1) ITBS scores in grade 8, 2) Enrollment in grade 9 (high school), 3) high school graduation, and 4) college enrollment. Results of the study demonstrated a correlation between grade 3 reading performance and grade 8 reading performance ($r=.67$). Results also found that students performing on or above grade-level in reading by third grade are more likely to enroll in and graduate college than students performing below grade-level in third grade (Lesnick et al. 2010). Furthermore, students that did not reach grade-level equivalents in reading by the end of third grade were more likely to drop out of high school as well (Lesnick et al. 2010). Due to the educational and professional repercussions associated with reading below grade-level in third grade, it is essential to isolate and combat the factors preventing students from reaching grade-level equivalents through evidence-based instruction.

Reading from an Educational Approach

According to the National Reading Panel (2001), there are five techniques that are present in effective reading instruction: phonemic awareness, phonics, fluency, teaching vocabulary words, and reading comprehension strategies. With this information, gathered from thousands of studies, there is a clear definition of what should be included in reading instruction in order to make it most effective for students. Additionally, the National Reading Panel's analysis of reading instruction found that the best approaches to reading instruction are ones that incorporate explicit instruction in phonemic awareness, systematic phonics instruction, fluency practice, vocabulary, and strategies that facilitate

comprehension (NICHD, 2001). Educational psychologists, linguists, and behavior analysts have various definitions of these concepts.

Phonological awareness. From an educational standpoint, Catts & Kamhi (2012) defined phonological awareness as the ability one has to manipulate, and understand the speech/sound structure found in words. According to a large body of research regarding phonological awareness, the acquisition of this skill may be essential to the trouble-free acquisition of literacy in terms of decoding and word recognition (Catts & Kamhi, 2012). Research has demonstrated that the majority of individuals who experience reading disabilities are lacking phonological awareness (Catts & Kamhi, 2012). According to Catts and Kamhi (2012), there are a number of activities that are essential to building phonological awareness in students. Some of these activities include blending, segmenting, isolating initial sounds, rhyming, and manipulating individual phonemes (Catts & Kamhi, 2012).

From a linguistic standpoint, an individual's phonological awareness plays an essential role in the way the brain codes individual words (Goswami, 2000). As a child develops, he/she begins to code the smaller units of sound, phonemes, into larger units of meaning. Initially, words can be coded as whole units due to a lack of vocabulary and experience; however, as an individual's vocabulary grows subtle phonemic differences become essential to the coding and restructuring of new words (Goswami, 2000).

Vocabulary. According to Armbruster et al. (2001), as cited in Paul and Wang (2012), vocabulary is defined as the words an individual must have in his/her repertoire in order to communicate effectively across all domains: listening, speaking, reading and writing. Having a literate vocabulary is essential for individuals to create relationships

among objects and events in the environment in a written forum (Catts & Kamhi, 2012). Furthermore a strong vocabulary, as well as schemas associated with literate language, is essential for the facilitation of strong comprehension (Catts & Kamhi, 2012).

From a linguistic standpoint, vocabulary is essentially dependent on an individuals' ability to segment and restructure phonemic representations of words. As an individual is exposed to new words, fine phonemic discriminations are essential to expanding his/her vocabulary (Goswami, 2000). For an individuals' vocabulary to rapidly expand, restructuring of phonological representations as well as rich language experiences are important linguistic factors that must be present (Goswami, 2000).

Reading fluency. Oral reading fluency is defined as reading out loud, with feedback from an experienced reader, to increase accuracy and automaticity of reading skills (NICHD, 2001). Reading fluency requires both phonemic and phonological awareness in order to create words from smaller units of meaning. According to *The Literacy Dictionary: The Vocabulary of Reading and Writing*, fluency is defined as “ the freedom from word identification problems that might hinder comprehension” (Harris & Hodges, 1995, p.85). This definition highlights the role of reading fluency in the acquisition of fluent comprehension in that individuals who are able to decode words with automaticity are more readily able to comprehend what they are reading (Pikulski & Chard, 2005). In order to fully include the role of comprehension in the definition of reading fluency, Pukilski and Chard (2005) proposed a comprehensive definition, which states:

Reading fluency refers to efficient, effective word recognition skills that permit a reader to construct the meaning of text. Fluency is manifested in accurate, rapid,

expressive oral reading and is applied during, and makes possible, silent reading comprehension.

Reading Comprehension

Researchers have defined reading comprehension multiple ways based upon both the processes and products of comprehending a text (Catts & Kamhi, 2012). The processes of comprehension are the strategies used to derive meaning from a text, while the products of comprehension are the end result: having an understanding what has been read (Catts & Kamhi, 2012). The Research and Development (RAND) Reading Study Group (RRSG, 2002) defined reading comprehension as “the process of simultaneously constructing and extracting meaning through interaction and engagement with print.” Although this describes the processes through which comprehension occurs, Catts & Kamhi (2012) suggest a definition that combines both the processes and the products of comprehension to fully encompass the scope of comprehension. Snow (2010) considers information about the reader, the text, and the activity measuring comprehension as key components for predicting comprehension success for students. Snow (2010) theorizes that combination of these three factors contribute to an individual’s ability to successfully comprehend a text.

A challenge in assessing reading comprehension is in the difficulty of defining it and determining its borders. For example, what types of questions should be included when assessing an individual’s comprehension of a text? Are explicit questions more telling of an individual’s ability to understand a text than implicit questions, or vice versa? Furthermore, what type of response is sufficient to determine if the reading was

comprehended? As stated earlier, comprehension exists on a continuum, with various levels of comprehension; which makes it difficult to reliably test.

Reading comprehension strategies. According to Paul and Wang (2012), individuals who experience deficits in language comprehension typically have poor vocabularies, low metalinguistic awareness, faulty or limited background knowledge, and have difficulty using cognitive and metacognitive strategies.

Research conducted in the field of reading has identified composite skills that are necessary to facilitate comprehension of texts. Fluent decoding and word recognition skills, paired with background knowledge are essential prerequisite skills for comprehending (Catts & Kamhi, 2012). Many theorists have outlined models of text comprehension to explain how children learn to derive meaning from what they have read. There are a number of models related to discourse level processes; one of them is Kintsch's Theory of Text Processing (Dijk & Kintsch 1978).

Kintsch's theory of text processing. Kintsch's Theory of Text processing asserts that comprehension exists on a continuum, and that it is a global construct that presents itself in the same way whether the student is reading or listening to the information needed to be comprehended (Dijk & Kintsch 1978). Kintsch states that a person's comprehension falls on a continuum between text model understanding and situation model understanding. Text model understanding is defined by Kintsch as a weaker, shallow understanding of the information being read by an individual (Dijk & Kintsch 1978). A student who is functioning at a text model level of comprehension can comprehend some of what is being read through both the words they know from the text (vocabulary) and a vague understanding of the topic due to the structure of the text. On

the other end of the spectrum, the situation model encompasses a deeper understanding of the text that is being read (Dijk & Kintsch 1978). Students who are functioning at a situation model level can create a deeper understanding of the content by using the domain specific and general world knowledge they have acquired over time, coupled with their language ability and understanding of text structure, to comprehend texts. Students who can create a situation model of understanding usually have extensive knowledge on the topic being covered before reading the text they are trying to comprehend. All students can fall on any end of this continuum depending on what type of text they are reading based on their background knowledge of the subject matter.

Where students fall on this continuum is dependent on the strength of their prerequisite reading repertoires. According to Catts & Kamhi (2012), the two most important factors for facilitating reading comprehension are 1) the ability to accurately and fluently decode words and 2) the ability to understand spoken language.

Furthermore, an individual's background knowledge, reading engagement, and inferencing skills affect their performance on both listening and reading comprehension tasks. Research has shown that the best predictor of comprehension, both written and listening, is often content knowledge. In fact, poor decoders can sometimes perform better than strong decoders when they have background knowledge of the topic (Catts & Kamhi, 2012). Therefore, knowledge deficits are attributed to the education gap between our high performing and low performing students.

Text factors

Besides prerequisite skills and content knowledge, there are a number of text factors that can affect the way in which an individual comprehends a text (Catts &

Kamhi, 2012). Some of these text factors include the readability and clarity of writing, text structure/genre, and characteristics such as font size/type, layout, and graphics. Although text factors can significantly affect reading, they have not been shown to be the cause of reading difficulties (Catts & Kamhi, 2012).

In recent years, various text factors have come into play when assessing the comprehension of elementary students. For many students performing below grade-level, the use of pictures in stories has been used as a tactic to increase comprehension of texts (Lui, 2004). In a study conducted by Lui (2004), undergraduate ESL students were given high and low level texts, counterbalanced between receiving comic strips corresponding to the text, or no comic strips at all. Results of a three-way ANOVA demonstrated that the use of comic strips for low-level students on high-level texts significantly increased comprehension of these texts, while the comic strip tactic provided no significant difference in comprehension for high-level students reading the same high-level texts. The author of this study suggested the use of visual cues for students who could not access the higher-level material across all reading instruction as a comprehension aid, but did not suggest how this would assist in the comprehension of texts when visual aids were not present (Lui 2004). This study demonstrates how text based factors, such as the use of pictures, can alter an individuals' comprehension of a text. Furthermore, Lui credits the success of the use of comic strips with dual coding theory, the mental model, noticing, and the repetition hypothesis (Lui 2004).

Instructing with and without pictures present. Results such as these beg the question of the usefulness of pictures when teaching students who are performing below grade-level to read. As early as 1938, researchers have been interested in the increasing

number of pictures and illustrations used in textbooks aimed to teach individuals to read (Miller, 1938). A study conducted by Miller (1938) assessed the effects of instructing typically developing students with and without pictures present in a basal reader on comprehension gains. The students were given a pretest followed by instruction using the same basal reader with or without pictures present. At the end of the school year, the students were given a post-test to assess comprehension gains. The results of the study demonstrated no difference in comprehension gains for students who were instructed with or without pictures in the basal reader. Results such as these demonstrate that the inclusion of pictures may not be necessary in aiding in the comprehension of texts (Miller 1938). Although the inclusion of pictures may not be necessary in aiding in comprehension, the ability to create “mental imagery” from the text being read may be an integral part of comprehension (Gambrell & Jawitz, 1993).

Visualizations and Mental Imagery

Gambrell & Jawitz (1993) conducted a study to assess whether instruction on how to create mental imagery had an effect on comprehension and recall. The participants of this study were 120 fourth graders that had comprehension scores either one standard deviation below or one standard deviation above the mean on the California State Achievement Test. The participants were broken up into four groups: induced mental imagery and attention to text (visualizations and pictures), induced mental imagery (visualizations and no pictures), attention to text illustrations (pictures only), and general memory (no pictures). Results of this investigation demonstrated significant comprehension gains when pictures were available combined with the mental imagery component (Gambrell & Jawitz, 1993). The researchers concluded that the combined

strategy was the most effective in increasing comprehension; and they argue that the pictures in the text create a bridge to build background knowledge to transform written language into mental images (Gambrell & Jawitz, 1993). This is consistent with numerous theories from various disciplines that assess the role of visualization on reading comprehension, such as Dual Coding Theory (Paivio, 1971), Theory of Generative Learning (Wittrock, 1987), and Transactional Theory (Rosenblatt, 1978). Although the use of pictures to create mental imagery can be an effective strategy to increase comprehension of fictional texts, as students begin to age pictures are faded out of texts, which will render this strategy useless in many cases.

Dual coding theory. Dual Coding Theory (Paivio, 1971) has been used to explain the connection between visualizations and language as it pertains to reading comprehension. In Dual Coding Theory, there are two separate systems of coding that are responsible for the understanding of verbal and non-verbal representations in the environment: the verbal code and the imagery code (Paivio & Sadoski, 2013, p.29). The verbal coding system codes logogens, which are verbal representations; and the imagery coding system codes imagens, or nonverbal objects and events. In order to create understanding from the logogens and imagens represented, recoding within the verbal systems must occur to form bidirectional relations between the two (Paivio & Sadoski, 2013, p.30). There are three levels of processing that are responsible for the coding of verbal and non-verbal stimuli in the environment: representational processing, referential processing, and associative processing. These three levels aide in the activation of mental representations associated with reading and the relations between them (Paivio & Sadoski, 2013, p.58).

Representational processing involves the activation of mental representations through the use of text features. This involves the stimulus present (the word, letter, or number) and the context in which it is presented (Paivio & Sadoski, 2013, p.58). The author gives the example of a circle. In the same font with no context, a circle could be interpreted as the letter “O”, the number “0”, or the geometric shape. However, if placed in the middle of a word or number, the context would allow the reader to represent the visual stimulus as either a letter or a number (Paivio & Sadoski, 2013, p. 58). This ability to contextualize verbal and non-verbal representations can be seen when completing a fill-in the blank test or a crossword puzzle. Although the word is not present, the context surrounding the blank sets the occasion for an individual to derive meaning from the blank (Paivio & Sadoski, 2013, p. 59).

Referential processing explains the relations between visual stimuli, auditory stimuli, and verbal stimuli. For example, the spoken word “cup” may evoke a visual representation of a cup or the word “c-u-p” in textual form (Paivio & Sadoski, 2013, p.59). The relations between these stimuli are categorized as “one to many” in that one name may represent a variety of different stimuli, just as one stimulus may be categorized by a variety of different names (Paivio & Sadoski, 2013, p.59). The stimuli that evoke various mental representations are tied to the individual context through which the relation was learned, and are directly tied to a person’s background knowledge and personal experience. Furthermore, referential processing is more likely to evoke mental imagery based upon the concreteness of the stimulus present. If a stimulus appears in the environment, and is not an abstract construct, it is more likely to undergo referential processing and evoke mental imagery (Paivio & Sadoski, 2013, p.60).

Associative processing refers to the expanding of these active representations within the same categorization or system (Paivio & Sadoski, 2013, p.60). Reading a word in a particular context may evoke other representations of stimuli in the same class of items. Paivio and Sadoski give the example of reading the word cup. Not only does it evoke the pronunciation of the word cup, but it may also evoke the visualization of a saucer, spoon, and coffee that may be associated with a cup (Paivio & Sadoski, 2013, p.60). As an individual begins to read, and the person's individual experiences within the context of the words become more evident, non-verbal associations that are in the same class may continue to be evoked until an entire mental image of the scene is evoked (Paivio & Sadoski, 2013, p.60).

Reading from a Behavioral Approach

Verbal Behavior Developmental Theory (VBDT)

Verbal Behavior Developmental Theory (VBDT) applies Skinner's theory of verbal behavior to empirical research conducted in the field of applied behavior analysis in order to create a trajectory of child development (Greer & Keohane, 2005). This body of research identifies the verbal capabilities through which a child develops language functions throughout the lifespan (Greer & Keohane, 2005). This theory explains how children develop verbal repertoires from 1) pre-listener, 2) listener 3) speaker, 4) speaker-listener exchanges, 5) speaker as own listener, 6) reader, 7) writer, 8) writer as own reader (self-editor), & 9) advanced verbal mediation to solve problems (Greer & Keohane, 2005). The research conducted by VBDT theorists identified various verbal cusps and capabilities that needed to be induced in order to effectively educate students both academically and socially. Through this research, protocols have been created to

mirror specific environmental experiences that can evoke these cusps and capabilities for students who do not have them in repertoire (Greer & Keohane, 2005).

Cusps and Capabilities

There are certain behavior changes that function as developmental cusps, which allow individuals to expose their repertoires to new environments such as reinforcers, punishers, new contingencies, stimulus controls and responses (Rosales-Ruiz & Baer, 1996). Through these new contingencies, the student is able to quickly develop many new interactions with the environment (Greer & Ross, 2008). There are other behavior changes that function as capabilities, which are higher-order operants that when acquired allow for the incidental learning of new classes of operants (Greer & Ross, 2008). If a capability is not present, the acquisition of operants is not possible and subsequently impedes learning (Greer & Ross, 2008). If a developmental cusp also functions as a capability, the behavior change not only allows the individual to contact new environments, but also to learn classes of operants incidentally (Greer & Ross, 2008).

Students must acquire various cusps and capabilities in order to respond at the different levels of verbal behavior. Each verbal repertoire directly affects an individual's ability to learn from and interact with his or her environment. In terms of reading, an individual must exhibit 1) listener, 2) speaker, 3) listener-speaker exchanges, & 4) speaker as own listener repertoires before becoming a true reader.

The Role of the Listener

Skinner (1957) discusses the role of the listener in verbal episodes as a mediator of verbal behavior. When a speaker emits a verbal response, his or her behavior is either reinforced or punished by the behavior of a listener. Based upon the history of

reinforcement or punishment associated with the response, the likelihood of that behavior to occur again either increases or decreases. For example:

Speaker: (pointing to a flower) This flower is a violet.

Listener: You're right, that flower is a violet!

In this verbal episode, the listener has reinforced the speaker for identifying the violet, and therefore, the speaker is likely to emit similar verbal behavior in the presence of that stimulus in the future. However, not all verbal behavior is reinforced by a listener. For example:

Speaker: (pointing to a flower) This flower is a violet.

Listener: No, that flower is a lily. A violet is purple.

In this verbal episode, the speaker's verbal behavior is punished by the listener's behavior. The speaker incorrectly identified the flower, and through the mediation of a listener learned the response was incorrect. Due to this interaction between the speaker and the listener, the speaker in this verbal episode will be less likely to emit similar verbal behavior in the presence of that stimulus in the future. These two examples show how the mediation of a listener can result in an object acquiring stimulus control over an individual's verbal behavior.

The Role of the Listener in Reading

The same type of stimulus control can be acquired over words when a student learns to read. When a student is reading orally, or textual responding, in the presence of a listener the reader is acting as a speaker, and the individual listening is acting as a mediator. When the student reads a word correctly, and receives reinforcement from the listener for emitting the correct phonemes, he or she is more likely to emit those

phonemes in the presence of that word in the future. Likewise, if the student receives a correction for emitting incorrect phonemes in the presence of a word, he or she is less likely to emit those phonemes in the future. Learning to read requires the mediation of a listener to reinforce or correct utterances emitted in the presence of textual stimuli in order for the student to acquire proper stimulus control and relations between spoken and written words. Once students have acquired correct textual responses to words, it is now time to derive meaning from what is being read through answering questions that are relevant to the text.

As a speaker, individuals respond intraverbally to questions asked during a verbal episode. A listener, who either reinforces or corrects the response given by the speaker, then mediates the answers to those questions. For example, during a verbal episode, Student A asks, “What is the weather like outside?” Student B responds, “It is raining outside”, Student A looks out the window and sees it is raining and replies, “Thanks, it is raining outside.” In this example, the response of the speaker is reinforced 1) by the correspondence between the environment and what the speaker has said, 2) what the listener has observed in the environment, and 3) how the listener responds given that information. The individual’s behavior when answering questions is now reinforced by the correspondence with the environment as well as the listener’s response. Conversely, if Student A and Student B were having the same exchange, and Student B replied, “It is sunny outside,” when it is actually raining, Student A would not reinforce the response because Student B’s speaker behavior does not have correspondence with the events occurring in the environment. When individuals are first learning to respond intraverbally

to questions, the relations between spoken words and the environment are reinforced by the mediation of a listener.

When answering questions following the reading of a text, a similar exchange occurs within the skin of the reader. The reader textually responds to the words written on the page and relates them to stimuli in the environment. Following the textual responding to words, the student acts as a reader (listener) to read the questions presented. Following the reading of the question, the reader acts as a writer (speaker), and responds as a writer to the question presented. In order to answer the question, the writer must utilize the information he read and emit a written response based on that information. This rotation of the reader and writer within one's own skin is known as the speaker as own listener capability (Greer & Speckman, 2009).

Speaker as Own Listener Responding

According to Skinner (1957) verbal behavior is behavior that is reinforced through the mediation of a listener. Cantina (1998) expands on this notion by explaining how the listener's behavior is also mediated by the contingencies presented by the speaker, or the behavior of the speaker; which emphasizes the idea of an interlocking contingency between both the listener and the speaker. In order for a child to be truly verbal, he/she must have the functions of both a speaker and a listener in repertoire (Greer & Keohane, 2005). When an individual rotates between speaker and listener roles within one's own skin, he or she is said to be acting as a speaker as own listener (Greer & Speckman, 2009).

Greer and Speckman (2009) identified three capabilities that require speaker as own listener responding: naming, say-do correspondence, and self-talk. Arguably,

reading can be included as an advanced form of the speaker as own listener repertoire, as it involves a rotation of speaker and listener responses under the control of print stimuli (Greer & Keohane, 2005). In order to be an effective reader, an individual must be able to textually respond to the printed stimuli while simultaneously acting as a listener (combining his/her tact repertoire) to comprehend what is being read. According to Greer & Keohane (2005), even if a child is emitting correct textual responses to the print stimuli, if he/she does not have listener comprehension for those textual responses he/she “will not understand” what is being read. Due to this, it is essential to join the speaker as own listener repertoire with reader behavior in order to facilitate reading comprehension.

In terms of reader and writer behavior specifically, the naming capability joins print stimulus control for reading (Greer & Speckman, 2009). There have been a number of studies that examined the role of the naming capability on reader repertoires (Lee-Park, 2005; Helou-Care, 2008, & Riley-Lawson, 2008). These studies have shown how the listener repertoire joins textual responding in order to facilitate fluent comprehension.

Empirical Research on Naming and Reading

Lee-Park (2005) investigated the effects of multiple exemplar instruction on the transformation of stimulus function from naming to reading comprehension in preschool students diagnosed with developmental disabilities. In the first experiment, the participants were taught flashcards of either speaker or listener responses to mastery. Following the mastery of either the speaker or listener responses, probes were conducted for the untaught speaker or listener responses, as well as the untaught comprehension component by matching the symbols to the untaught written words. Following the

intervention, the participants who received instruction on the speaker responses emitted the untaught listener responses, but the participants who received instruction on the listener responses did not demonstrate mastery of the untaught speaker responses. Furthermore, none of the participants were able to respond at criterion level to the untaught reading comprehension component. During Experiment II, the participants were presented with a multiple exemplar instruction intervention across speaker and listener responses. Following completion of the intervention, all participants emitted the untaught naming and reading comprehension responses. The results of this investigation demonstrate how naming may be the cusp responsible for creating joint control between print and verbal functions (Greer & Speckman, 2009).

To extend the relation between naming, print control, and reading comprehension, Helou-Care (2008) conducted two experiments to test the effects of the naming capability on reading comprehension in middle school students who could fluently textually respond, but exhibited poor comprehension. A multiple exemplar instruction intervention across listener and speaker responses was used to teach novel tacts directly related to literal-based reading comprehension probes. Following criterion level responding for the multiple exemplar instruction intervention, the participants were given probes for the untaught reading comprehension responses. The participants were first taught to match a novel set of 5 contrived stimuli while simultaneously hearing the tact for the stimulus to criterion. Following criterion level responding to the match topography, the participants textually responded to a story containing the set of contrived stimuli. After 30 minutes, the participant was presented with untaught listener and speaker comprehension probes corresponding with the story. Results demonstrated that following the multiple exemplar

instruction intervention to induce naming all participants responded at criterion level to the reading comprehension probes, thus showing a relation between reading comprehension and the naming capability (Helou-Care, 2008). This study demonstrates the relation between an individual's tact repertoire for visual stimuli and fluent textual responding.

The Tact Repertoire and Reading

The relationship between the tact repertoire and textual responding is essential to learning to read and comprehend texts. Exhibiting joint stimulus control across the tact repertoire and textual responding will allow students to more readily comprehend the textual responses he/she is emitting. In order to have joint stimulus control across textual responding and the tact repertoire (comprehension), one must have the ability to learn incidentally; meaning the naming capability joins textual responses and comprehension. Greer and Ross (2008) cite joint control when naming joins print control as the basis for fluent reading and writing repertoires. This joint control explains how stimuli in different media can be joined together to create new responses.

Skinner (1957) discusses the way in which individuals can emit the same response in different media, resulting in functionally equivalent responses. Skinner (1957) describes these responses in terms of speaking and writing, giving the example of the same word emitted across speaker and writer topographies. Because speaking and writing are different behaviors, but deliver functionally equivalent responses, he describes them as the same response across different types of operants (Skinner, 1957). These equivalent responses across different types of operants allow for verbal episodes to be emitted between individuals through various channels. As speaking and writing are

functionally equivalent responses, reading and listening are as well. Listening to a story spoken aloud, or reading a story covertly to oneself produce functionally equivalent outcomes: to comprehend and respond to what is being read. Although reading and listening share some functionally equivalent outcomes, there are aspects of each that are not in direct relation with the other (Skinner, 1957). However, without the combination of fluent listener responses, an individual's reader repertoire would be nonexistent. The listener responses that occur within one's own skin that allow an individual assign meaning to written words through an association with his/her tact repertoire can be described through conditioned seeing (Skinner, 1953).

Conditioned seeing

Skinner first defined conditioned seeing as an individual seeing or hearing stimuli, which are not present in the physical environment, based on the pattern of a conditioned reflex (Skinner, 1953). Put simply, an individual is likely to "see" any stimulus, not only when it is present in the environment, but also when a stimulus it has been paired with in the past is present (Skinner, 1953). Skinner gives the example of the pairing of the dinner bell with food. Through multiple pairings of the dinner bell with a subsequent meal, upon hearing the bell ring one may "see" the dinner he or she is about to eat (Skinner, 1957). Although the dinner itself is not present, the dinner bell may evoke a Pavlovian response in the presence of a particular stimulus.

The notion of conditioned seeing can explain why individuals see the world based upon his/her instructional history (Skinner, 1953). Skinner explains how we more readily "see" stimuli that are familiar to us, than ones that are not. He gives the example of catching a glimpse of a bird as it flies by. If the bird is familiar to us, we are more

likely to “see” it distinctly as it flies overhead, versus a bird we are not familiar with (Skinner, 1953). Familiarity with an object is essential to connecting conditioned responses in our environment with other events and stimuli.

In his 1957 book, Skinner returns to the idea of conditioned seeing, explaining it as it pertains to reading. From a behavioral perspective, conditioned seeing, which coincides with the term mental imagery, can be described as a private event or a behavior that occurs within ones’ own skin (Skinner, 1957). Skinner (1957) defines conditioned seeing as the behavior of seeing an image within ones’ own skin in the absence of a visual stimulus. Skinner discusses conditioned seeing in terms of stimulus control. If a reader of a text is truly able to come under the stimulus control of what is being read, the reader will be able to “see” what is being described (Skinner, 1957). Seeing the image within ones own skin, in the absence of a visual stimulus, can evoke a response that can affect the behavior of the individual. For example, Skinner uses the example of reading a novel and reacting emotionally to what is being written. He uses the example of the death of Little Nell in Charles Dickens’ *The Old Curiosity Shop*, by stating that a reader will emotionally react to the death of the dog not only through coming under the verbal stimulus control of the words “death” and “dog”, but through the images the reader is able to produce through reading the statements (Skinner, 1957). This type of stimulus control is only possible when individuals are able to equate textual and visual stimuli to one another.

Research on conditioned seeing. Shanman (2013) assessed the relation between the listener and speaker components of naming and conditioned seeing. Experiment I utilized a naming experience to expose the participants to the contrived stimuli for the

naming probe. Following the naming experience, unsequenced probe trials were conducted for listener, speaker, and drawing responses. Results demonstrated a correlation between the drawing and speaker responses. Experiment II utilized a delayed phonemic response intervention to increase the number of correct responses to naming probes, as well as the drawing component. Results demonstrated that the students who demonstrated the speaker component of naming also demonstrated the drawing responses. Shanman (2013) concluded that the development of the conditioned seeing repertoire, measured by the drawing response, is related to visual object-name relations seen in the development of the naming repertoire. The emergence of these relations in children can be explained through the presence of derived relational responding.

Derived Relational Responding

The presence of derived relational responding connects texts to experiences and stimuli in the environment that can allow a child to visualize what is being read and learn in new ways. A number of theorists have speculated how human beings are able to acquire these relations across spoken language and other operants incidentally, or without direct instruction. Arguments have been made across various schools of thought outlining the ways in which humans acquire operants that are seemingly untaught. These theories include Stimulus Equivalence, Relational Frame Theory, and Naming Theory (Sidman & Tailby, 1982; Hayes, Barnes-Holmes, & Roche, 2001; & Horne & Lowe, 1996).

Stimulus equivalence. Sidman and Tailby (1982) proposed that the incidental acquisition of operants occurs from the creation of stimulus classes, which he defines through the relations of reflexivity, symmetry, and transitivity. Through these relations,

individuals acquire equivalence classes, which allow them to equate seemingly unrelated stimuli to one another. Sidman extrapolated his theory from the mathematical definitions of reflexivity, symmetry, and transitivity, and utilizes the relevant equations to explain the relations.

Reflexivity is defined as aRa (a to a relation, R = relation), or responding to a one to one relationship between stimulus classes. This relation is commonly known as identity matching. For example when shown a picture of a dog, if a child responds to another exemplar of a dog he or she is said to be demonstrating reflexivity (Sidman & Tailby, 1982). Symmetry is defined as aRb then bRa , which means that stimulus class a is interchangeable with stimulus class b ; this can be simply stated as “if a then b ” to “if b then a ” (Sidman & Talby 1982). For example, if a child is explicitly taught that when shown a picture of a dog to respond with the spoken word “dog”, and then responds by pointing to a picture of a dog when hearing the spoken word “dog” without explicit training; the symmetric relation is said to have emerged. Lastly transitivity is defined as if aRb and bRc then aRc , meaning the organism responds to stimulus class a as it does to stimulus class c after being explicitly trained on the ab and bc relations (Sidman & Tailby, 1982). For example, after being explicitly taught that when shown a picture of a dog, stimulus class a , responding with the spoken word “dog”, stimulus class b , is correct; and when hearing the spoken word “dog”, stimulus class b , responding by pointing to the written word “dog”, stimulus class c , is correct; then when shown a picture of a dog, stimulus class a , the subject would point to the written word “dog”, stimulus class b , without being explicitly taught.

When these three properties are all present within a singular subject, stimulus equivalence is demonstrated. According to Sidman, these relations can account for how humans are able to respond across multiple topographies to different variations of the same stimulus, and learn language in different forms seemingly incidentally (Sidman & Tailby, 1982). Other theorists extended Sidman's framework in order to incorporate the complexities of verbal behavior.

Relational frame theory. In order to account for the complexities of verbal behavior, Hayes and colleagues (2001) suggested the Relational Frame Theory of Stimulus Equivalence, which included a new set of terms to describe the ways in which individuals equate various stimuli to one another in order to acquire classes of stimuli, rather than to just describe the procedures through which individuals acquire language as Sidman had done. Hayes and colleagues created frames through which individuals are able to respond relationally to arbitrary stimuli through an extension of the mathematical relations Sidman had proposed. Hayes and colleagues defined these terms as relational reflexivity, mutual entailment, and combinatorial entailment to coincide with Sidman's reflexivity, symmetry, and transitivity (Hayes et al. 2001).

Relational reflexivity is a prerequisite to all arbitrary relational responding, as it requires the individual to respond to the properties of the stimulus itself, or perform basic identity matching. Hayes argues that instead of calling it reflexivity, it should be called relational reflexivity because the individual must be able to abstract the relation of "sameness" across different contexts (Hayes et al. 2001). For example, the student must be able to demonstrate that the letter "A" typed on a paper is the same as the letter "A" written on a whiteboard. This salience across different topographies of the letter "A", or

of any given stimulus is a demonstration of relational reflexivity. This example highlights how the context surrounding the stimulus creates the relation between the salient features of the stimulus in order to create an equivalent relation.

Mutual entailment is the idea that if an individual learns to equate stimulus a to stimulus b, they will be able to produce the derived relation between stimulus b and stimulus a without direct instruction. Hayes decides upon the term mutual entailment rather than symmetry because the arbitrary relations between stimulus a and stimulus b may not necessarily be equal, but the individual is able to equate the two stimuli to one another (Hayes et al. 2001). Hayes focuses on the idea that any stimulus, regardless of whether or not it is truly equal to its counterpart, can be a part of a relation such as this. An example of mutual entailment is transformation of stimulus function across saying and writing. Although spelling letters aloud and writing letters on a piece of paper are not necessarily equal (people write to produce speaker behavior, where as saying letters would only function as a tact) if a student learns to write a word on a piece of paper, he or she will be able to demonstrate mutual entailment by spelling the word aloud without direct instruction. Instances such as this highlight the importance of viewing these relations as truly arbitrary versus equivalent.

Combinatorial entailment, which is Hayes' term for transitivity, is the idea that any trained relations sharing a stimulus in common, regardless of whether or not they are equal or opposite, will combine to form two derived relations (including that of mutual entailment) without direct instruction meaning: if an individual is taught a frame in which stimulus a is related to stimulus b (aRb), and stimulus b is related to stimulus c (bRc), then stimulus a is related to stimulus c (aRc) within that particular context, and stimulus c

is related to stimulus a (cRa) without any explicit instruction (Hayes et al. 2001). Hayes argues that through these frames, individuals are able to learn various operants within particular contexts without direct instruction. Relational Frame Theory focuses on the idea that these relations are controlled by the contexts through which they are acquired in order to form frames of responding for particular stimuli in the presence of specific controlling variables. Another theory that speculates how individuals acquire relations between the environment and verbal behavior is naming theory.

Naming. Naming is a fundamental verbal repertoire that is essential for the incidental learning of speaker and listener responses without direct instruction (Gilic & Greer, 2011). Naming, because it allows individuals to learn in new ways, functions as a verbal developmental cusp that is also capability (Greer & Speckman, 2009). Naming theory was first introduced by Horne and Lowe (1996), and was described as the most basic verbal unit that functions as a higher-order bidirectional, behavioral relation that joins together speaker and listener behavior (Horne & Lowe 1996). This joining of the speaker and listener behavior allows for individuals to access the environment in a way they could not before.

According to Greer and Ross (2008), naming can be defined as the phenomenon through which students acquire speaker and listener responses without direct instruction. According to the model, a child with naming is able to respond to a stimulus as both a speaker and listener through the experience of hearing an adult tact an object in the environment and observing the corresponding stimulus (Greer & Ross, 2008). As a verbal developmental cusp that is a capability, naming allows children to acquire new

language through observation and other forms of indirect instruction, which is an essential component for success in most educational settings (Greer & Speckman, 2009).

In typically developing children, naming emerges through incidental learning experiences encountered in the environment through adult interactions (Horne & Lowe, 1996). A child/caregiver interaction that acts as an incidental naming experience involves the presence of a stimulus, a caregiver emitting a tact for the stimulus, and the use of social reinforcement across experiences in order for the child to learn how to respond in the presence of the stimulus; making the object, as well as the caregiver, a discriminative stimulus (Horne & Lowe, 1996). However, in some children the naming capability does not always emerge incidentally, and direct instruction is sometimes required to induce it. A number of studies have outlined the experimental measures taken to induce naming in developmentally disabled individuals, as well as young children, who did not acquire naming incidentally (Fiorile & Greer, 2007; Gilic, & Greer, 2011; Greer, Stolfi, Chavez-Brown & Rivera-Valdez, 2005).

If a child has naming in repertoire, as well the pre-requisite skills to textually respond to words, he or she is increasingly likely to comprehend the text as well as connect what the author is writing to events and objects in his or her environment. However, if the stimulus read about in the book is not physically present or illustrated in a text, it could be argued that the child would not be able to make that connection to objects in his or her environment if conditioned seeing is not present. Currently, research has not been conducted to assess whether the presence of naming and conditioned seeing have an effect on students' comprehension of texts with and without pictures or illustrations present.

Synthesis of Behavioral and Educational Approaches to Reading

Both the educational and behavioral approaches to reading describe a set of skills or repertoires through which students learn to textually respond to and derive meaning from words in order to comprehend the information being read. Each approach uses its own terminology, which describes the processes or relations through which individuals master functionally equivalent skills. For example, each approach defines the way in which an individual reads a word using varying terminology. From the behavioral approach textually responding is defined as:

A verbal operant involving a response that is evoked by a verbal discriminative stimulus that has point-to-point correspondence between the stimulus and the response product, but does not have formal similarity between the stimulus and the response (Skinner, 1957).

From an educational approach, Perfetti (1985) defined decoding as “the ability to transform printed letter strings into a phonetic code.” Although both approaches define the skills using different terminology and processes, they each produce a functionally equivalent outcome: to read words.

There are numerous parallels between educational and behavioral reading terminology, which can tie together the two approaches in order to create a unified understanding of the process through which individuals learn to read and comprehend texts. Table 1. Outlines the parallels between the two approaches with definitions for each term.

Table 1.

Parallel Behavioral and Educational Definitions of Reading Related Terminology

Behavioral Reading Terminology		Educational Reading Terminology	
<u>Terms</u>	<u>Definitions</u>	<u>Terms</u>	<u>Definitions</u>
Textual responding	A verbal operant involving a response that is evoked by a verbal discriminative stimulus that has point-to-point correspondence between the stimulus and the response product, but does not have formal similarity between the stimulus and the response (Skinner, 1957)	Decoding	The ability to transform printed letter strings into a phonetic code (Perfetti, 1985)
Tact Repertoire	Object-word relations that allow individuals to assign names to stimuli in the environment. Hearing/reading a word evokes a relation between a stimulus in the environment facilitating comprehension. These relations are formed through pairings with the stimulus and the written/spoken word in the individual's environment.	World Knowledge	An individual's knowledge of the world that allows him/her to comprehend what is being read. Different types of world knowledge: Specific Content Domains: Academic subjects, Classes of Animals, etc. Procedural Knowledge: How to make a sandwich, how to tie a shoelace, etc. Interpersonal Knowledge: Thoughts, feelings, actions of others.
Speaker as Own Listener (Reading)	The rotation between speaker and listener roles within one's own skin. In order to be an effective reader, an individual must be able to textually respond to the printed stimuli while simultaneously acting as a listener (combining his/her tact repertoire) to comprehend what is being read.	Comprehension	The process of simultaneously constructing and extracting meaning through interaction and engagement with print.
Naming joins reading	Joint stimulus control across the tact repertoire and textual responding allows students to more readily comprehend his/her textual responses. In order to have joint stimulus control across textual responding and the tact repertoire (comprehension), one must have the ability to learn word/object relations incidentally.	Kintch's Theory of Text Processing (Situation Model Understanding)	Situation model understanding of a text allows individuals to create a deeper understanding of the content by using the domain specific and world knowledge they have acquired over time, coupled with their language ability and understanding of text structure, to comprehend text.

Conditioned Seeing	The behavior of seeing an image within ones' own skin in the absence of a visual stimulus.	Mental Imagery	Constructing a mental image using prior knowledge to create a vivid representation of prose.
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The Present Study

The purpose of the present study is to determine the frequency of the presence of the naming capability in students performing below, on, or above grade-level in reading. The body of research related to naming and reading suggests that students who have naming in repertoire will have better reading comprehension than students who do not have naming in repertoire (Helou-Care, 2008). Furthermore, the present study aims to determine the frequency of the presence of drawing responses to a stimulus in the absence of a visual model for students performing below, on, or above grade-level for reading as a measure of conditioned seeing. If a student can visualize the stimuli being tacted in the environment or being written about in a story, he or she will be increasingly likely to comprehend what is being read.

Research Questions

1. Determine the frequency of the presence of the naming capability for contrived stimuli for students performing below, on, and above grade-level for reading
2. Determine the frequency of the presence of the drawing response to a stimulus in the absence of a visual model for students performing below, on, or above grade-level for reading.
3. Is there a relationship between free and reduced lunch status and the naming capability?
4. Is there a relationship between English-Language Learner status and the naming capability?

Chapter II

Experiment I Methods

Participants

The participants of this study were 36 third grade students and 8 fourth grade students ($n = 44$) recruited from CABAS inclusion classrooms in a Title 1 public school. Of the 44 participants, 21 were male, 23 were female, and 7 students were diagnosed with a disability. In regards to socioeconomic status and ethnicity, 31.8% of students received free or reduced lunch, 63.6% were White, 6.7% were African American, 25% were Hispanic or Latino, and 4.5% were Asian. Furthermore, 43.2% of the students were performing below grade-level, 29.5% were performing on grade-level, and 27.3% were performing above grade-level in reading. Tables 2 and 3 give further descriptions of the participants.

Table 2.

<i>Description of Participants</i>		
<i>Variable</i>	<i>N</i>	<i>Percent</i>
Gender	M=24 F=20	M= 54.5% F=45.5 %
Diagnosed with a Disability	7	15.9%
Free/Reduced Lunch	14	31.8%
English- Language Learner	9	20.5%
Reading Grade- level	Below=19 On=13 Above= 12	43.2% 29.5% 27.3%

Table 3.

<i>Race/Ethnicities of Participants</i>		
<i>Race/Ethnicity</i>	<i>N</i>	<i>Percent</i>
White	27	63.6%
African American	3	6.7%
Hispanic/Latino	12	25%
Asian	2	4.5%

Participants were grouped into categories of below, on, and above grade-level based on the score of his/her most recent i-Ready® diagnostic test. The i-Ready® diagnostic test is a computer-based adaptive assessment which assesses both on and off grade-level skills, by adjusting the items presented based upon student ability levels (Curriculum Associates, 2014). Numerous studies have been conducted linking i-Ready® reading diagnostic scores to 1) proficiencies on common core based assessments, and 2) Lexile® levels. Table 4 gives a description of the cut-off i-Ready score for each group.

Table 4.

<i>i-Ready® Reading Diagnostic Score Groupings</i>		
<i>Reading Grade-Level</i>	<i>Cut-off Score</i>	<i>Score Range</i>
Below	≥525	411-525
On	≥550	527-550
Above	≤ 551	551-625

Note: Cut off scores for below, on, and above grade-level were determined based upon normative performance at the middle of the grade-level. Below = below third grade-level. On= middle of third grade-level, and Above= end of third grade-level or above.

When grouped according to reading grade-level, the descriptions of the participants in the below (n=19), on (n=13), and above (n=12) grade-level groups were as follows. Of the 19 participants in the below grade-level group, 12 were male, 7 were female, and 4 students were diagnosed with a disability. In regards to socioeconomic status and ethnicity, 52.6% of students received free or reduced lunch, 42.1% were English Language learners, 42.1% were White, 15.7% were African American, and 42.1% were Hispanic or Latino. Of the 13 participants in the on grade-level group, 4 were male, 9 were female, and 2 students were diagnosed with a disability. In regards to socioeconomic status and ethnicity, 15.4% of students received free or reduced lunch, 7.7% were English Language learners, 69.2% were White, 15.4% were Hispanic or Latino, and 15.4% were Asian. Lastly, of the 12 participants in the above grade-level group, 8 were male, 4 were female, none of the students were diagnosed with a disability or were English Language Learners. In regards to socioeconomic status and ethnicity, 1 student received free or reduced lunch, 91.7% were White, and 1 participant was Hispanic or Latino. Tables 5 & 6 outline the descriptions of the below, on, and above grade-level groups.

Table 5

Description of Participants By Grade Level

	<i>Below</i>		<i>On</i>		<i>Above</i>	
<i>Variable</i>	<i>N</i>	<i>Percent</i>	<i>N</i>	<i>Percent</i>	<i>N</i>	<i>Percent</i>
Gender	M=12 F=7	M= 63.1% F=36.8%	M=4 F=9	M= 30.8% F=69.2 %	M=8 F=4	M= 66.7% F=33.3%
Diagnosed with a Disability	4	21.1%	2	15.4%	0	0%
Free/Reduced Lunch	10	52.6%	2	15.4%	1	7.6%
English-Language Learner	8	42.1%	1	7.7%	0	0%

Table 6

Race/Ethnicities of Participants By Grade Level

	<i>Below</i>		<i>On</i>		<i>Above</i>	
<i>Race/Ethnicity</i>	<i>N</i>	<i>Percent</i>	<i>N</i>	<i>Percent</i>	<i>N</i>	<i>Percent</i>
White	8	42.1%	9	69.2%	11	91.7%
African American	3	15.7%	0	0%	0	0%
Hispanic/Latino	8	42.1%	2	15.4%	1	7.6%
Asian	0	0%	2	15.4%	0	0%

Procedure

Participants were recruited through convenience sampling from third and fourth-grade CABAS® AIL classrooms located in a publicly funded elementary school outside a major metropolitan area. These classroom employed the CABAS® AIL (Comprehensive Application of Behavior Analysis to Schooling, Accelerated Independent Learner) method, which is a learner-driven and data-driven school-wide approach to education based on the comprehensive application of the science of behavior analysis (Greer, 1998). The presence or absence of the listener and speaker components of naming, as well as the

students' drawing responses in the absence of the stimuli presented, were tested using a naming experience. All sessions occurred directly outside of the classroom at a round table located in the hallway.

Measures

The dependent variables for the present study were the number of correct responses emitted to untaught listener and speaker responses following a naming experience using contrived stimuli, and the number of correct stimuli drawn by the participants following the naming probes.

Experimental Design & Procedure

The naming experience, probes for the listener and speaker components of naming, and the drawing response were conducted as per Shanman's (2013) investigation on naming and conditioned seeing. The contrived stimuli were symbols that the students did not have an instructional history with paired with an arbitrary consonant-vowel-consonant (CVC) word such as mer, dep, or hap. The stimuli used for the naming experience are outlined in Table 7.

Table 7.

<i>Stimuli used during Contrived Naming and Drawing Probes</i>	
<i>Stimulus Name</i>	<i>Stimulus</i>
Kaj	⌘
Gox	∫
Nuc	≡
Sir	≈
Pid	Φ
<i>Note:</i> Stimuli were paired with arbitrary consonant-vowel-consonant words at random.	

Naming experience. All students were delivered a naming experience for contrived stimuli, in which the experimenter individually presented the names for the five

target stimuli four times each. The individual presentation of each stimulus with its name is called a tact presentation. During tact presentations, stimuli were displayed via a PowerPoint® presentation with one stimulus on each slide. The experimenter stated the name of each stimulus on the screen for the participant, but did not require a response. Following the naming experience, the experimenter waited at least two hours before presenting the probes for the untaught speaker, listener, and drawing responses.

Naming probes. During the probes for untaught listener and speaker responses, the participant was presented with the “point-to” topography first, followed by the tact and intraverbal responses. Each of the responses was presented in 10 trial blocks, and the participants received neither reinforcement nor correction for their responses. During the point-to response, the participants were required to point to the target stimulus in a field of three following the vocal antecedent “Point to ____”. During the tact response, the participants were required to say the name of the stimulus on the screen without a vocal antecedent from the experimenter. During the intraverbal response, the participants were required to say the name of the stimulus following the antecedent “What is this?” or “What is the name of this?” Criterion for the listener component of naming was 80% across the point-to response topography, criterion for the speaker component of naming was 80% across the tact and intraverbal response topographies, and criterion for full naming was 80% across all three-response topographies.

Conditioned seeing probes. Following the probes for the untaught speaker and listener responses, the participants were given a paper with five blank boxes and the vocal antecedent “Draw the pictures you just saw”. The participants were then required to draw the stimuli presented during the tact instruction. Criterion for the presence of the

drawing component was 4 out of 5 correct stimuli drawn or 80% correct responding. An example of the drawing response probe can be seen in Appendix A.

Results

The first and second research question assessed the frequency of the naming capability and the drawing component. Results of the present analysis demonstrated that 65.9% of the students had the listener component of naming, 29.5% of the students had the speaker component of naming and full naming, and 40.9% of the students had the drawing component (Figure 1.).

When broken down by below, on, and above grade-level in reading groups, 57.8% of the below grade-level students had the listener component of naming, 10.5% of the below grade-level students had the speaker component of naming and full naming, and 21.2% of the below grade-level students had the drawing component (n=19). Of the on grade-level students (n=13), 46.2% had the listener component of naming, 30.8% had the speaker component of naming and full naming, and 53.8% had the drawing component. Of the above grade-level students (n=12), 100% had the listener component of naming, 58.3% had the speaker component of naming and full naming, and 58.3% had the drawing component (Figure 2.).

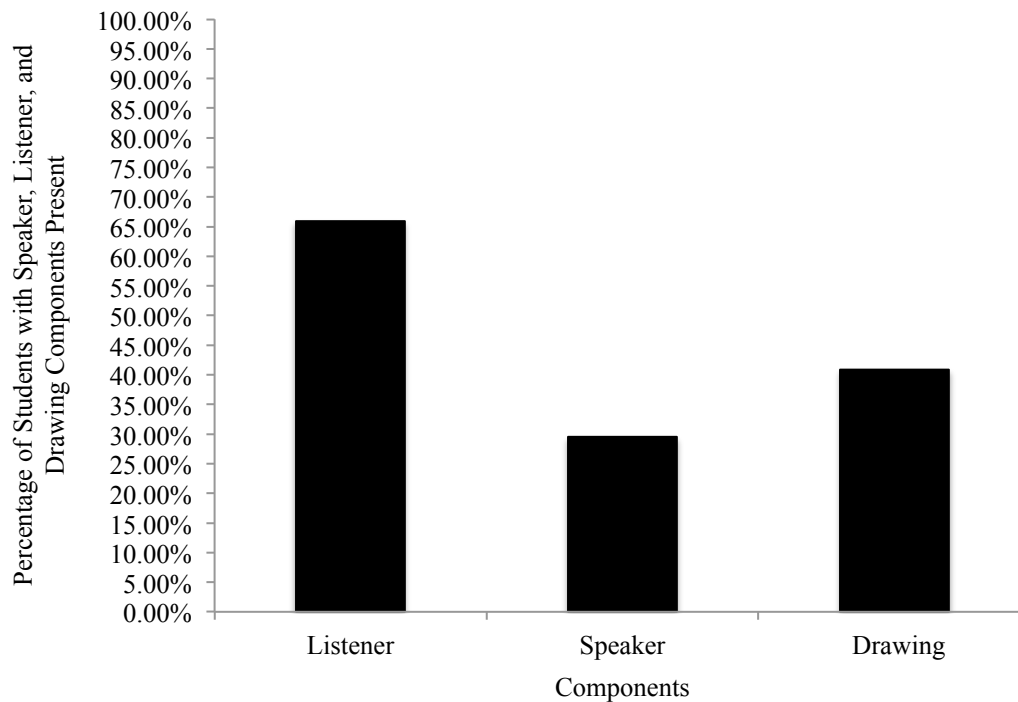


Figure 1. represents the percentage of correct responses to unconsequated probes for listener, speaker, and drawing components presented for all participants (n=44).

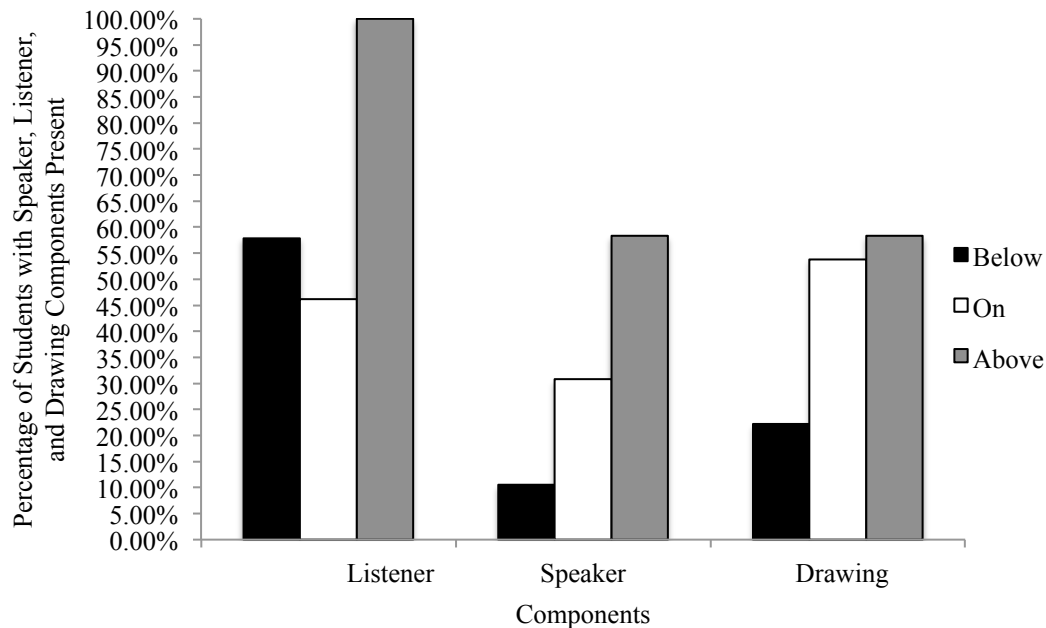


Figure 2. represents the percentage of correct responses to unconsequated probes for listener, speaker, and drawing components presented for students performing below, on, and above grade-level in reading.

The third research question determined if there was a relationship between free and reduced lunch status and the naming capability within the sample. Results demonstrated that there was a moderately significant negative correlation between free and reduced lunch status and the naming capability $r(44) = -.288, p = .058$.

The fourth research question determined if there was a relationship between English Language Learner status and the naming capability within the sample. Results demonstrated that there was a significant negative correlation between free and reduced lunch status and the naming capability $r(44) = -.343, p = .022$.

Discussion

The results of the present study indicate that as compared to their on and above grade-level counterparts, the below grade-level students have lower instances of naming and conditioned seeing. The largest discrepancies between the below grade-level students and their on and above grade-level counterparts were in the areas of the drawing component and the speaker component of naming. While only 22.2% of the below grade-level students exhibited the drawing component, 53.8% of the on grade-level students and 58.3% of the above grade-level students did. Furthermore, only 10.5% of the below grade-level and 30.8% of the on grade-level students exhibited the speaker component of naming, while 58.3% of the above grade-level students did.

The demographic makeup of each of the groups should be noted as well. The below grade-level group was primarily comprised of minority students who received free and reduced lunch, whereas the on and above grade-level groups were comprised of predominately white middle-class students. The results of the correlational analysis revealed significant negative correlations between the naming capability and 1) free and reduced lunch status and 2) English Language Learner status. The differences in language experiences due to socioeconomic status

and native language for the below grade-level students could be a contributing factor to the lack of the full naming capability.

As stated previously, naming develops in young children through child/care-giver interactions. A child/caregiver interaction that acts as an incidental naming experience involves the presence of a stimulus, a caregiver emitting a tact for the stimulus, and the use of social reinforcement across experiences in order for the child to learn how to respond in the presence of that stimulus (Horne & Lowe, 1996). These interactions require a language-rich environment, which includes a high frequency of child/caregiver interactions, in order to facilitate naming as well as other important milestones in childhood development.

Research has demonstrated that early language experience and interactions between children and their caregivers has a significant impact on student's language accomplishments going forward (Hart & Risley, 1995). The language experiences of children from upper-middle class homes differ greatly from that of children in disenfranchised homes, which in turn creates an educational gap between the two groups of individuals (Hart & Risley, 1995). Therefore, the lack of language experiences received by both the minority students, as well as the free and reduced lunch students may have an effect on the presence of the naming capability, as well as reading performance in the below grade-level group.

Furthermore, the differences in reading comprehension levels may be due to the students' lack of a strong production response repertoire, which includes behaviors such as drawing and speaking, stemming from a lack of language experiences. If students do not have strong production response repertoires, paired with the behavior of seeing a stimulus within one's own skin, comprehension may suffer when visual representations of events and characters are not present. An additional experiment will be conducted to assess whether or not the presence of

visual stimuli during reading has an effect on the below, on, and above grade-level students' comprehension of a story.

The Present Study

The purpose of the present study is to determine whether or not the naming capability and the behavior of visualizing what is being read are necessary for comprehension of texts without pictures present. Furthermore, the present study aims to investigate whether these capabilities are correlated with students performing below, on, or above grade-level in reading. This extends the current body of research because few studies to date have been conducted on the role of visualization and the use of illustrations in texts as they relate to reading comprehension, as most studies focus only on listening comprehension skills (Gambrell & Jawitz, 1993).

Research Questions

1. Is there a difference in mean comprehension scores for reading texts with and without pictures present for students performing below, on, or above grade-level?
2. Is there a relationship between drawing a representation of a stimulus in the absence of a visual model and comprehension for texts without pictures present?
3. Is there a relationship between naming and the comprehension of texts without pictures present?

Chapter III

Experiment II Methods

Participants

The participants of the present study were the same as Experiment I. See Tables 2, 3, 4, 5 & 6 for detailed descriptions of the participants.

Procedure

Participants were recruited through convenience sampling from third and fourth-grade CABAS® AIL classrooms located in a publicly funded elementary school outside a major metropolitan area. These classroom employed the CABAS® AIL (Comprehensive Application of Behavior Analysis to Schooling, Accelerated Independent Learner) method, which is a learner-driven and data-driven school-wide approach to education based on the comprehensive application of the science of behavior analysis (Greer, 1997). Students' comprehension of texts with and without pictures was assessed based upon their responses to explicit comprehension questions. All sessions occurred within the participants' classroom, either at a brown, rectangular table located in the back of the classroom, at the child-sized student desks clustered in groups of four to five desks; or directly outside the classroom at a round table located in the hallway.

Measures

Comprehension questions. The dependent variable for the present study was the number of correct responses to reading comprehension questions. Each question was an explicit comprehension question, which required the participant to recall information directly stated in the text. Each story varied in length and subject matter, and had between 8-10 comprehension questions explicitly related to the text. Students were required to produce the answers to the comprehension questions in written form on the lines below the antecedent.

During administration, the participant was given a third grade-level text selected from the McGraw Hill Reading Wonders Curriculum®(McGraw Hill, 2014), and was required to read the text silently to his or herself. Following the reading of the text, the story was removed from the student, and he or she was given a set of comprehension questions. The experimenter and at least one independent observer scored each answer to the comprehension questions.

Independent Variable

The independent variable was the presence or absence of pictures in the texts. The texts given were Lexile® leveled readers from the McGraw Hill Reading Wonders Curriculum® (McGraw Hill, 2014). Each story selected was within the third grade Lexile® range of 540-780. The Lexile® ranges and mean comprehension scores across each story are presented in Table 8.

Table 8.

Lexile® Leveled Stories for Comparison

<i>Story</i>	<i>Lexile® Level</i>	<i>Mean Score</i>	<i>Median Score</i>	<i>Score Range</i>
Berries, Berries, Berries	540	P=84% N=70%	P=85% N=78%	P=50-100% N=0-100%
Jungle Treasures	560	P=62% N=65%	P=72% N=52%	P=0-100% N=0-89%
Best Friends in Business	780	P=70% N=67%	P=80% N=75%	P=5-100% N=16-94%
Jokes on You	640	P=61% N=66%	P=72% N=69%	P=22-89% N=22-100%

Note: The Lexile ® scale is a developmental scale for measuring reader ability and text complexity. Lexile levels range from 0L for beginning-reader materials to 1700L and above for advanced-reader materials.

The students were given a copy of the story with pictures present, or without pictures present, and their responses to comprehension questions were scored. The stories were counterbalanced across participants and conditions to assess the effects of pictures on comprehension. The stories with and without pictures present were identical to one another, except the pictures were cut out of the stories for the without pictures condition. Examples of the stories with and without pictures can be seen in Appendix B.

During administration, the participant sat at his or her desk and read a story that either contained words and visual representations of events and characters or only words. Following the completion of the story, the paper story was removed from the participant, and he or she was handed a question set. The participant was asked to independently complete the questions without feedback from the teacher or access to the text. The comprehension questions were answered in written form, and scored for content only. Spelling and grammar were not accounted for while scoring the written comprehension questions.

Results

The first research question assessed whether there was a difference in mean comprehension scores when pictures were not present for students performing below, on, or above grade-level in reading. A Kruskal-Wallis Test was used to test the differences between groups in their comprehension scores during the with and without pictures conditions. Results demonstrated that there were significant differences in comprehension scores between the three groups during the with pictures condition $\chi^2(2, N=44) = 24.38, p = 0.00$ and the without pictures condition $\chi^2(2, N=44) = 33.47, p = 0.00$.

During the with pictures condition, a Mann-Whitney U analysis revealed that children performing below grade-level had significantly lower comprehension scores than the above grade-level students $z = -4.545, p = .000$ and the on grade-level students $z = -3.323, p = .001$.

However, there was no difference in performance during the with pictures condition for the on and above grade-level groups students $z = -1.691, p = .091$.

During the without pictures condition, a Mann-Whitney U analysis revealed that children performing below grade-level had significantly lower comprehension scores than the above grade-level students $z = -4.627, p = .000$ and the on grade-level students $z = -4.283, p = .000$. The analysis also revealed that children performing on grade-level for reading had significantly lower comprehension scores during the without pictures condition than students performing above grade-level $z = -3.378, p = .000$. Figures 3, 4, & 5 1) display the mean differences in comprehension scores with and without pictures between the three groups, 2) the distribution of comprehension scores for the without pictures condition for students performing below, on, and above grade-level in reading, and 3) and the difference in performance for the with and without pictures condition within each group.

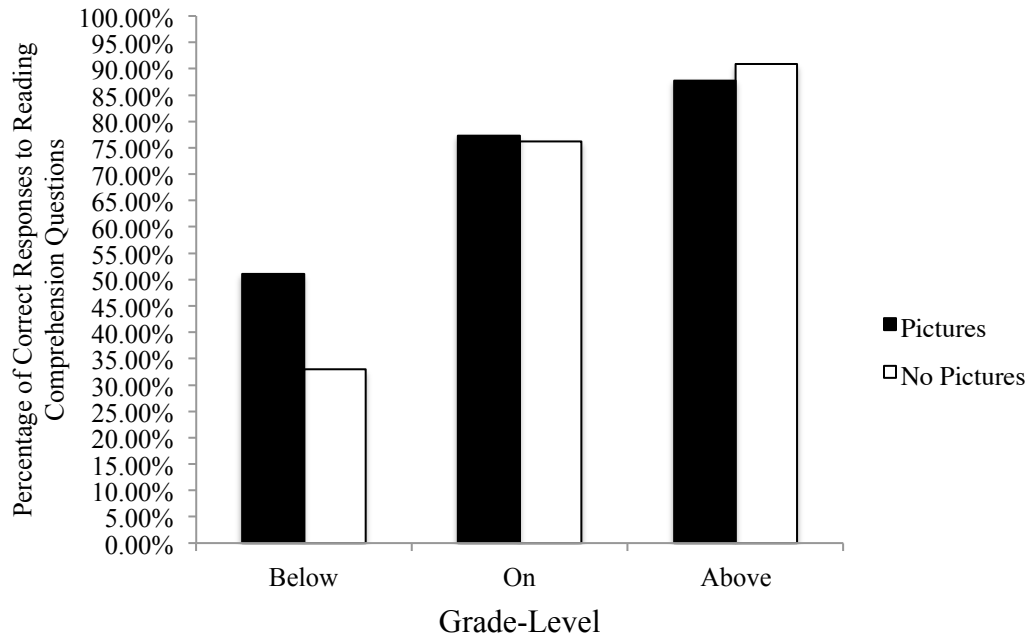


Figure 3. represents the mean percentage of correct responses to comprehension questions for texts with and without pictures present for students performing below, on, and above grade-level in reading.

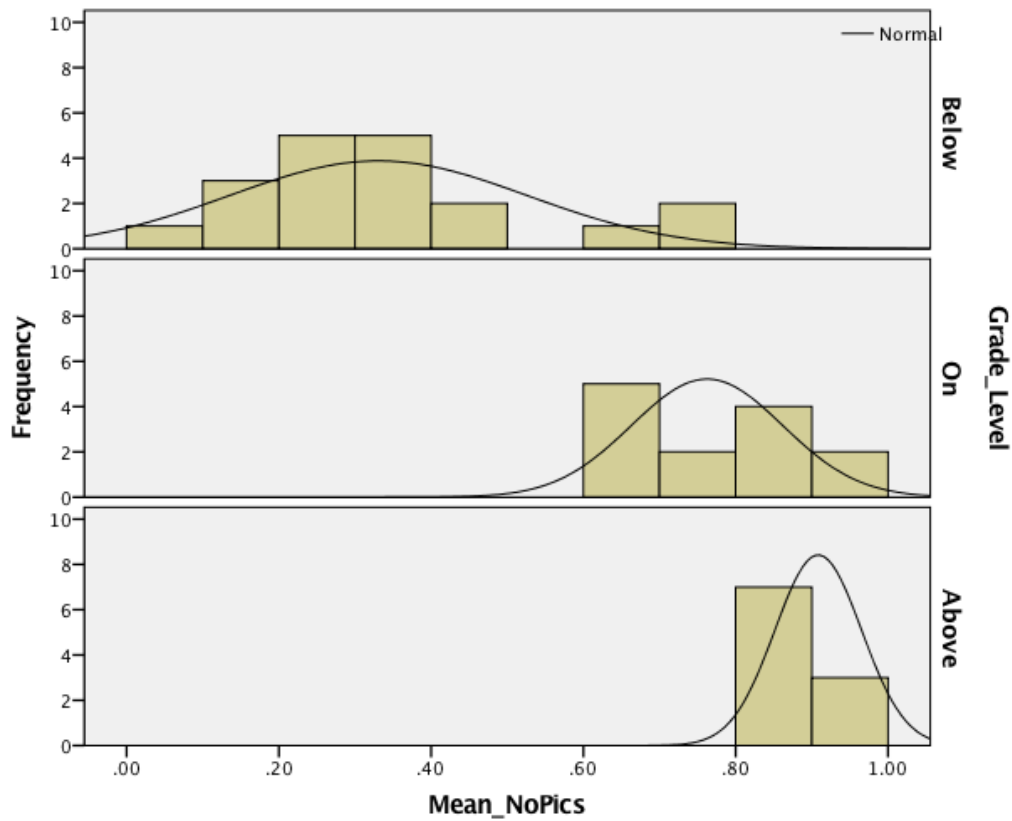


Figure 4. represents the comprehension score distribution for students performing below (N=19), on (N=13), and above (N=12) grade-level for reading.

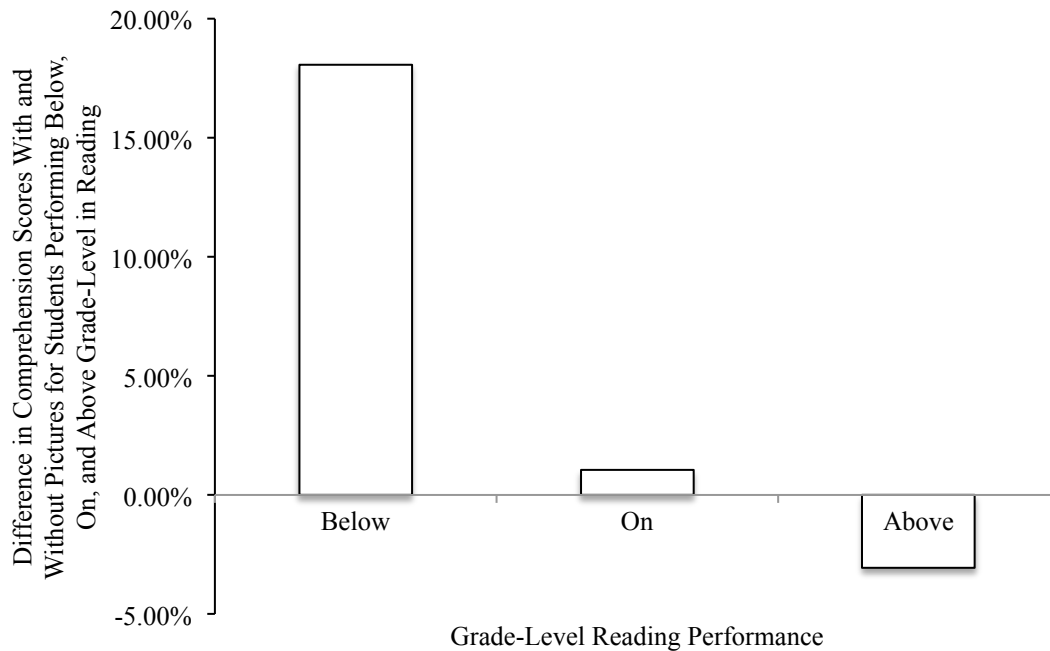


Figure 5. represents the difference in comprehension scores with and without pictures present for students performing below (N=19), on (N=13), and above (N=12) grade-level for reading.

The second research question assessed whether there was a correlation between the mean comprehension score without pictures and the number of components accurately drawn for the drawing component. Results demonstrated that there was a significant positive correlation between mean comprehension scores and the number of components drawn, $\rho (44) = .412, p = .005$.

The third research question assessed whether there was a correlation between reading on, above, or below grade-level and the presence of the speaker component of naming. Results demonstrated that there was a significant positive correlation between reading on, above, or below grade-level and the presence of the speaker component of naming, $\rho (44) = .479, p = .001$.

Discussion

The results of the present analysis demonstrated a significant difference in comprehension scores during the without pictures condition for students performing below grade-level as compared to their on and above grade-level counterparts. Furthermore, there was a significant difference in comprehension scores during the without pictures condition for students performing on grade-level and their above grade-level counterparts. There was also a significant difference in comprehension scores during the with pictures condition between the students performing below grade-level in reading and their on and above grade-level counterparts.

As stated previously, the demographic composition of the below-grade-level group was primarily minority students, with a large portion of English Language Learners and students receiving free and reduced lunch. The structure of this group may have played a significant role in the participants' scores during the comprehension probes, as research has demonstrated the relationship between socioeconomic status and language acquisition (Hart & Risley, 1995). Vocabulary, which is built through acquiring language incidentally, is essential for individuals to

create relationships among objects and events in the environment in a written forum (Catts & Kamhi, 2012). Furthermore a strong vocabulary, as well as schemas associated with literate language, is essential for the facilitation of strong comprehension (Catts & Kamhi, 2012). From a behavioral perspective a functional tact repertoire allows individuals to equate stimuli in the environment with written and spoken words. The relation between stimuli in the environment and both written and spoken words can be tied back to a child's acquisition of language. Children who can equate written and spoken words to stimuli in their environment, whether or not the stimuli are physically present, will more readily comprehend than children who cannot.

The results also demonstrated a significant correlation between the number of components drawn and mean comprehension scores. Therefore, these data suggest that the behavior of visualizing stimuli within one's own skin may be a necessary cusp to comprehend texts when pictures and illustrations are not present. The listener responses that occur within one's own skin that allow an individual assign meaning to written words through an association with his/her tact repertoire can be described through conditioned seeing (Skinner, 1953).

It should be noted that there was no significant difference in comprehension between the on and above grade-level groups when pictures were present, which is consistent with the literature (Gambrell & Jawitz, 1993; Miller, 1938; Lui, 2010). This indicates that the presence of pictures is a text-based factor that functions as prompt for visualizing stimuli and connecting background knowledge in order to comprehend texts. Although effective, this prompt should be replaced with an additional strategy, as pictures become increasingly sparse as students age.

The Present Study

Due to the discrepancies in comprehension in the below grade-level group for texts with and without pictures present, the current study aims to increase comprehension for texts without pictures present by using a visualization technique. Experiment III utilized a computer program

for students to generate visual representations of stories being read in order to facilitate comprehension. The storyboard will be used to bridge the gap between what is being read and visual representations of the stories made by the students to increase comprehension.

Research Questions

1. Will the sequencing and production of a storyboard to match components of a narrative increase comprehension for texts without pictures present?
2. Will the sequencing and production of a storyboard to match components of a narrative increase the number of components drawn correctly as a measure of conditioned seeing?
3. Will the sequencing and production of a storyboard to match components of a narrative increase the number of correct responses to contrived naming probes?

Chapter IV

Experiment III

Participants

The participants of the present study were 6 third grade students without disabilities. The participants were recruited from CABAS inclusion classrooms in a Title 1 public school. Of the 6 participants, 3 were male and 3 were female. In regards to socioeconomic status and ethnicity, 2 of the students received free lunch, 4 students were White, one student was Hispanic, and one student was African American. The participants were chosen for this study because their reading comprehension for stories without pictures present was significantly lower than their comprehension for stories with pictures present. Refer to Table 9. for a more detailed description of the participants.

Table 9.

Description of Participants

Participant	A	B	C	D	E	F
Age	8	8	8	8	8	8
Gender	F	M	M	F	M	F
Free/Reduced Lunch	No	Yes	No	No	No	Yes
I-Ready® Reading Score & Grade-level Equivalents	519	496	505	421	512	512
Comprehension Literature Grade-level Equivalents	Early 3	Level 2	Level 2	Level 1	Early 3	Early 3
Lexile® Levels	645	540	580	200	615	610

Note: i-Ready® Reading scores are compiled using the diagnostic examination which measures phonological awareness, vocabulary, high-frequency word identification, and comprehension of literary and informational texts. The reading materials used during the test are computerized, and contain visual representations.

Setting and Materials

The present study was conducted in a third-grade CABAS® AIL classroom located in a publicly funded elementary school outside a major metropolitan area with twenty-one students, one teacher, and two teaching assistants. The classroom within the school employed the CABAS® AIL (Comprehensive Application of Behavior Analysis to Schooling, Accelerated Independent Learner) model, which is a learner-driven and data-driven school-wide approach to education based on the comprehensive application of the science of behavior analysis (Greer, 1998). This method to schooling uses an interlocking operant, called the learn unit (Albers & Greer, 1991), to deliver all instruction. All sessions occurred within the participants' classroom, either at a brown, rectangular table located in the back of the classroom or at the child-sized student desks clustered in groups of four to five desks; or directly outside the classroom at a round table located in the hallway.

The materials for Experiment III were as follows. For the pre-and post-intervention probes, a third grade-level text with or without pictures present, a set of comprehension questions, a pen and a pencil were utilized (Same as Experiment II). During the intervention, a third grade-level text without pictures present, a set of comprehension questions, a laptop computer, a pen and a pencil were utilized.

Dependent Variables

The dependent variables for the present study were the number of correct responses emitted to comprehension questions during the pictures versus no pictures conditions, and the number of correct responses emitted to naming probes for contrived stimuli.

Comprehension questions. The first dependent variable was the number of correct responses to reading comprehension questions answered by each participant. Each question was an explicit comprehension question, which required the participant to recall information directly

stated in the text. Each story varied in length and subject matter, and had between 8-10 corresponding comprehension questions explicitly related to the text. Students were required to produce the answers to the comprehension questions in written form on the lines below the antecedent.

Comprehension question probe procedure. During administration, the participant was given a third grade-level text to read. The texts given were Lexile® leveled readers from the McGraw Hill Reading Wonders Curriculum (McGraw Hill, 2014). The students were given a copy of the story with pictures present or without pictures present. Besides the presence or absence of pictures, the stories utilized were exactly the same in terms of font size and paragraph formation. For the without pictures condition, the pictures were cut out of the leveled readers, but the formation of the paragraphs remained the same. Appendix B shows examples of the leveled readers with and without pictures present. The stories were counterbalanced across participants and conditions to assess the effects of pictures on written comprehension questions. Tables 10 & 11 outline the stories used for the pre-and post intervention comprehension probes for each participant, and the Lexile® levels of each story respectively. Following the completion of the story, the paper story was removed from the participant, and he or she was handed a question set. The participant was asked to independently complete the questions without feedback from the teacher or access to the text. The comprehension questions were answered in written form, and scored for content only. Points were not deducted for spelling and grammar on the written comprehension questions. Furthermore, the participants did not receive reinforcement or corrections for correct or incorrect responses to comprehension questions.

Table 10.

Without Pictures Stories for Each Participant Pre-and Post Intervention

Participant	A	B	C	D	E	F
Pre-1	Jokes On You	Jokes On You	Berries, Berries, Berries	Berries, Berries, Berries	Berries, Berries, Berries	Jokes On You
Pre-2	Jungle Treasures	Jungle Treasures	Best Friends in Business	Best Friends in Business	Best Friends in Business	Jungle Treasures
Pre-3	—	—	Stepping Forward	Bikes Forever	In the Running	Faraway Home
Pre-4	—	—	Salvage Crew	The Great Book Swap	Salvage Crew	Charlie's Pet Problem
Pre-5	—	—	Dan's Idea	In the Running	Dan's Idea	Storm Surprise
Post-1	In the Running	A Chef in the Family	Charlie's Pet Problem	A Chef in the Family	Bikes Forever	In the Running
Post-2	Salvage Crew	The Great Book Swap	Faraway Home	Storm Surprise	Stepping Forward	Bikes Forever
Follow Up	Charlie's Pet Problem	Dan's Idea	Harry's Great Idea	Harry's Great Idea	—	—

Table 11.

Lexile® Levels for Pre- and Post Intervention Stories

Story	Lexile® Level
Berries, Berries, Berries	540
Chef	540
The Great Book Swap	540
Harry's Great Idea	550
Charlie's Pet Problem	560
Jungle Treasures	560
Storm Surprise	570
Jokes On You	640
Faraway Home	660
Salvage Crew	670
In the Running	700
Stepping Forward	700
Dan's Idea	740
Bikes Forever	760
Best Friends in Business	780

Contrived naming probes. The second dependent variable for the present study is the number of correct responses emitted to untaught listener and speaker responses following a naming experience using contrived stimuli. The contrived naming probes followed the same sequence as Experiment II.

Contrived naming probe procedure. All students were delivered a naming experience for contrived stimuli, in which the experimenter presented tacts for the five target stimuli four times each. The contrived stimuli were symbols that the students did not have an instructional history with paired with an arbitrary consonant-vowel-consonant (CVC) word such as mer, dep, or hap. The stimuli sets for the naming experience for each participant are outlined in Table 8. During the naming experience, stimuli were displayed via a Powerpoint® presentation with one

stimulus on each slide. The experimenter pointed to the stimulus on the screen, and stated the corresponding name for the stimulus without a vocal antecedent. The participant was required to attend to the information provided, but was not required to emit an echoic response. Following the naming experience, the experimenter waited at least two hours before presenting the probes for the untaught speaker, listener, and drawing responses.

During the probes for untaught listener and speaker responses, the participant was presented with the “point-to” topography first, followed by the tact and intraverbal responses. Each of the responses was presented in 10 trial blocks, and the participants received neither reinforcement nor correction for their responses. During the point-to response, the participants were required to point to the target stimulus in a field of three following the vocal antecedent “Point to ____”. During the tact response, the participants were required to say the name of the stimulus on the screen without a verbal antecedent from the experimenter. During the intraverbal response, the participants were required to say the name of the stimulus following the antecedent “What is this?” or “What is the name of this?” Criterion for the listener component of naming was 80% across the point-to response topography, criterion for the speaker component of naming was 80% across the tact and intraverbal response topographies respectively, and criterion for full naming was 80% across all three-response topographies.

Drawing component probe procedure. Following the probes for the untaught speaker and listener responses, the participants were given a paper with five blank boxes and the vocal antecedent “Draw the pictures you just saw”. The participants were then required to draw the stimuli presented during the tact instruction, one in each of the corresponding boxes. Criterion for the presence of the drawing component was 4 out of 5 correct stimuli drawn, or 80% correct responding.

If a participant responded at criterion level for speaker and listener probes, a novel probe was delivered to the participant prior to the onset of the intervention using a set of stimuli the participant had not seen before. If the participant responded at criterion level to the novel probe, he/she was said to have full naming in repertoire; however, if the participant did not respond at criterion level to the novel probe, he/she was said not to have naming in repertoire. Tables 12 & 13 outline the sets of stimuli used for each participant pre-and post-intervention, as well as a description of the stimuli contained in each set respectively.

Table 12.


























Naming Probe Stimuli For All Participants

Participant	A	B	C	D	E	F
Pre-1	Set 2	Set 1	Set 2	Set 2	Set 2	Set 2
Pre-2				Set 2	Set 2	Set 2
Pre-3	—	—	Set 2	Set 2	—	Set 2
Novel	—	—	Set 3	Set 3	—	Set 4
Post-1	Set 2	Set 1	Set 4	Set 3	Set 2	Set 4
Novel	—	Set 3	—	—	—	Set 5

Note: Novel probes were only administered if participants responded at criterion level for both the speaker and listener responses during a probe session.

Table 13.

Sets of Stimuli For Contrived Naming Probes

Set 1	Kaj 	Gox 	Nuc 	Sir 	Pid 
Set 2	Hap 	Sut 	Bov 	Dem 	Mer 
Set 3	Des 	Vop 	Jus 	Lak 	Mef 
Set 4	Jev 	Zim 	Tul 	Fap 	Hod 
Set 5	Tal 	Bik 	San 	Rah 	Pil 

Note: All stimuli and c-v-c words were paired randomly & not in the participants' repertoire.

Independent Variable

The independent variable for the present study is the creation of pictures to match a narrative. During the intervention, the participant read a narrative without pictures present. Following reading the story independently, the participant made a storyboard with pictures that corresponded to the beginning, middle, and end of the story on an online computer program. Following the creation of the storyboard, the participants answered comprehension questions using their storyboard as a tool to facilitate the recall of events and information. After the participant completed both the storyboard and comprehension questions, the teacher provided learn units on correct and incorrect responses to the comprehension questions. The teacher provided feedback in the form of reinforcement for correct responses, or a correction for incorrect responses, which involved the teacher referencing the part of the storyboard that corresponded with the narrative or comprehension question and comparing it with the text.

Criterion for mastery was set at 90% correct responses to comprehension questions across two consecutive novel narratives.

Intervention sequence. The storyboard intervention took approximately one hour and twenty minutes to conduct per session, with an initial 20-25 minute training on the use of the storyboard website. The participant worked independently without feedback or interruption from the experimenter for approximately one hour, and received feedback from the experimenter for approximately 20 minutes dependent on the number of corrections. The sequence of the Storyboard Intervention was as follows: 1) The participant received a training session on the use of the storyboard website, 2) The participant read a narrative text without pictures present, 3) The participant created a storyboard based upon the narrative he/she read, 4) The participant used the storyboard to answer comprehension questions based on the narrative, & 5) The participant received feedback from the experimenter in the form of learn units. Figure 6. outlines the intervention sequence for all sessions.

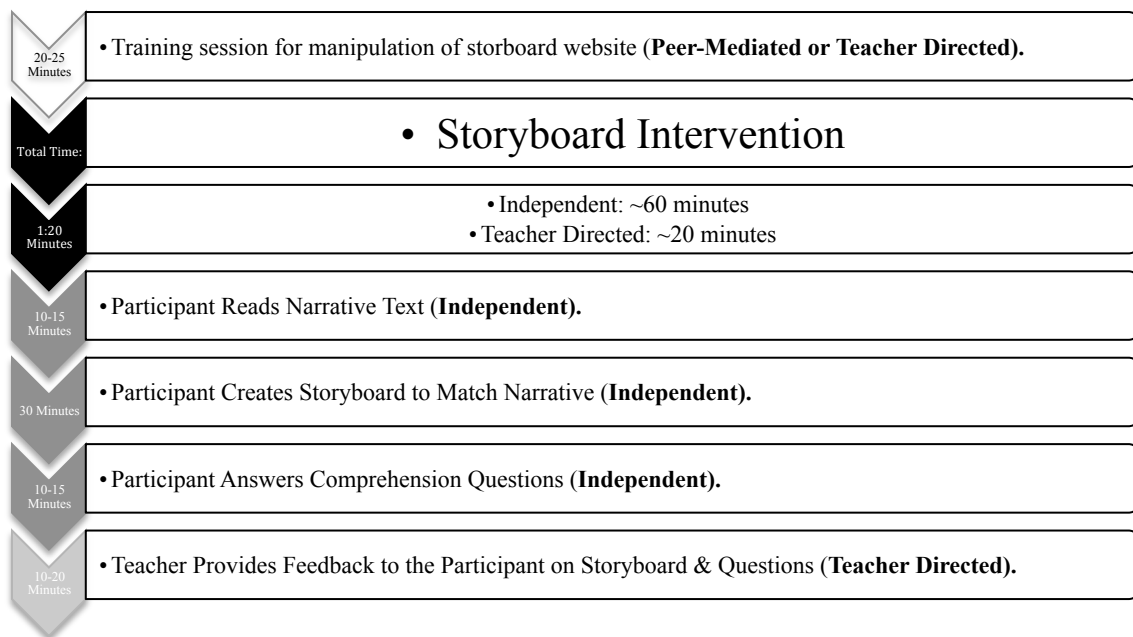


Figure 6. represents the intervention sequence for all participants.

Storyboard training. Prior to the intervention, the participants logged onto www.storyboardthat.com to become familiar with the manipulation of the stimuli on the website. The experimenter or peer instructed the participant on how to choose a setting, character, or prop that corresponded with a story and drag and drop it into the frames of a storyboard. The experimenter or peer demonstrated how the participant could change the color of an object, customize the characters to match the characters in a story, change the expressions/positions of the characters, resize the stimuli on the page to fit on the screen, and how to move, delete, or copy stimuli already made (See Appendix C for examples of the storyboard screen). Then, the teacher or peer provided the participants with scenarios to create practice frames. For example, the teacher or peer would say “create a frame including a girl with brown hair, wearing a blue tee-shirt and pink shorts taking a test at her desk at school.” The participant would then go into the scenes section, choose school, and find a classroom with desks. Then the participant would go into the characters section to find a girl with a tee shirt and shorts and change the colors of the tee shirt, shorts, and hair to match the description given in the scenario. The participant would then change the pose of the character to sitting, and rotate her body so that she is sitting at the desk. Finally, the participant would search for a paper or test, and a pencil to put on the desk to complete the scene. The participant would complete 1-2 short scenarios until he/she was fluent in manipulating the tools on the storyboard website. This training took approximately 25-30 minutes. Once the participant was fluent in manipulating the tools, he/she began the intervention.

Storyboard intervention. During the intervention, the participants were given a narrative story to read that contained specific details about events, settings, and characters. Each narrative story varied in length, ranging from 2-2.5 pages, and did not contain pictures within the

text (See Appendix D for a sample narrative). The story took approximately 10-15 minutes for the participant to read. Following the reading of a narrative without pictures present, the narrative was removed from the participant, and he or she was required to create a storyboard from memory.

The participant was given a laptop computer, and the direction to log on to www.storyboardthat.com. On the storyboard screen of the website, the participants were provided three “frames” in which they could produce three scenes from the narrative. If the participant wished to add additional frames, they were permitted to do so, but could not exceed 6 frames. Once on the storyboard page, the participants were given the direction to create a storyboard matching the beginning, middle, and end of the narrative he or she read. The participants chose the setting, characters, and props from a horizontal menu on the top of the screen. Once selected, the participants dragged and dropped the stimuli into each of the corresponding frames. The participants were able to manipulate the objects so that the color, size, expressions, and poses matched that of the setting and characters of the narrative. The storyboard intervention required the participants to match the setting, characters, and events to specific stimuli presented in the program. For example, if the story described a white, fuzzy dog, the participant was required to choose the white, fuzzy dog instead of the brown, spotted dog for his/her storyboard. The storyboard took approximately 30 minutes to create. Appendix E. gives examples of storyboards created by the participants throughout the intervention.

Comprehension questions. Following the creation of the storyboard, the participant was given a set of 8-10 comprehension questions and asked to complete the questions using the storyboard as a visual aid. The participant was allowed access to the storyboard to answer all questions, and was encouraged to use it as a visual to aid in answering the questions. During the

storyboard intervention, the participant only had access to the storyboard, and not to the text itself. The comprehension questions took approximately 10-15 minutes to complete. Following the completion of the comprehension questions, the participant was given learn units from the teacher on the correct and incorrect components for both the storyboard as well as the correct and incorrect responses to comprehension questions. An example of a comprehension sheet is displayed in Appendix F. The comprehension questions answered for each story can be seen in Appendix G.

Correction procedure. Following the completion of the storyboard intervention, the experimenter provided learn units to the participant on the correct and incorrect aspects of the storyboard and the comprehension questions. First, the experimenter read each of the comprehension questions and student responses aloud to the participant. If the participant answered the question correctly, a checkmark was placed next to the question and the participant was given reinforcement in the form of verbal praise (i.e. Good Job, Nice work, You're right ____ is the correct answer). If the participant answered the question incorrectly, the experimenter placed a check with a circle around it next to the question, and identified the paragraph in the story where the answer was located. The participant was then required to re-read the paragraph to find the corresponding correct answer. When the participant found the correct answer in the text, he/she wrote that answer underneath his/her original response on the paper. Reinforcement was not provided during the correction procedure.

The correction procedure for the storyboard component of the intervention proceeded in a similar manner. The experimenter went through each of the components of the participant's storyboard and reinforced the participant for the correctly identified components in the form of verbal praise, and provided corrections for the incorrectly identified components. During the

correction procedure, the experimenter identified the portion of the passage that contained the correct description of events and characters, and required the participant to re-read the section in order to find the correct answer. Once the correct answer was identified, the participant was required to edit his/her storyboard to match the story. Reinforcement was not provided during the correction procedure. The correction procedure took between 10-20 minutes to complete, dependent on the number of errors the participant made on both the storyboard and the comprehension questions.

Data Collection

Data were collected on the number of correct responses to comprehension questions out of the total number of questions, and how many accurate components the participant included in his/her storyboard out of the minimum number of components needed to be included. The experimenter and an independent reader read through the story and identified components that were necessary to the understanding of the story. They collaboratively created a data sheet that included each of the components they deemed necessary to the comprehension of the story to be used to score the storyboard component. An example of the data sheet used to score the picture components is displayed in Appendix H. The participants were not given extra points for more detailed descriptions than what was provided on the data sheet. The intervention continued until the participant emitted 90% correct responses to comprehension questions across two consecutive novel stories. Due to the subjective nature of the storyboard, the components included in the storyboard were measured for function only. Function was measured as the student creating a storyboard that matched the components of the story without misinterpretations of the plot.

Experimental Design and Procedure

A multiple probe design across three groups of two participants was used to test the effects of producing and sequencing narrative components of a story on written reading comprehension questions for students performing below grade-level in reading. Initial probe data were collected for all participants. Following the initial probe sessions, the first group entered the intervention. Once the first group responded at criterion level during the intervention, post-intervention probes were conducted. Following the post intervention probes, the second set of pre-intervention probes was conducted for the second group. The sequence followed as such for the remaining groups. Following the completion of the intervention by the final group, a follow-up probe was conducted for the first four participants determine if the participants maintained the comprehension gains made during the intervention. A visual representation of the design can be seen in Figure 7. All probe and intervention sessions were counterbalanced across participants to control for sequence effects.

Participants A&B	Pre-Intervention Probe #1	Intervention	Post Intervention Probe					Follow Up Probe
Participants C&D	Pre-Intervention Probe #1		Pre-Intervention Probe #2	Intervention	Post-Intervention Probe			Follow Up Probe
Participants E&F	Pre-Intervention Probe #1				Pre-Intervention Probe #2	Intervention	Post-Intervention Probes	

Figure 7. Represents the experimental sequence for all participants.

Design sequence. At the onset of the study, pre-intervention probes were simultaneously delivered to all participants entering the study. The pre-intervention probes consisted of 1) reading two stories without pictures present and answering comprehension questions, 2) reading two stories with pictures present and answering comprehension questions, 3) a naming

experience for contrived stimuli, and 4) a drawing response to contrived stimuli. Following the pre-intervention probes, the participants began the intervention. The intervention consisted of 1) reading a narrative without pictures present, 2) creating a storyboard to match the components of the narrative, 3) answering comprehension questions using the storyboard as a visual aid, and 4) receiving learn units on correct and incorrect responses. The post intervention probes followed the same sequence as the pre-intervention probes. Follow up probes were conducted for Participants A, B, C, & D following Participant E and Participant F's completion of the intervention. Table 14 outlines the stories used for each participant throughout the intervention.

Table 14.

Intervention Stories for Each Participant

Participant	A	B	C	D	E	F
1	Jesse & the Cat	The Bear Scare	Where is Spike?	The Spring Dance	Jesse & the Cat	The Spring Dance
2	The Bear Scare	Jesse & the Cat	The Bear Scare	Where is Spike?	The Bear Scare	Where is Spike?
3	The Spring Dance	The Soccer Game	The Impossible Pet Show	Prince Jacob	The Soccer Game	The Great Blizzard
4	The Soccer Game	The Spring Dance	The Soccer Game	The Impossible Pet Show	Where is Spike?	The Impossible Pet Show
5	Where is Spike?			The Soccer Game	Prince Jacob	
6	Prince Jacob				The Spring Dance	
7	The Impossible Pet Show				The Impossible Pet Show	
8					The Great Blizzard	
9					Mystery at the Mays	
10					Missing Sneakers	

Inter-Observer Agreement (IOA) & Inter-Scorer Agreement (ISA)

Pre-and post-intervention comprehension probes. Inter-scorer agreement was calculated for 100% of pre- and post-intervention probe sessions for all participants. An independent scorer read each story and scored the explicit comprehension questions. Scorers were instructed to mark a minus (-) for incorrect responses, .5 for partially correct responses, and a plus (+) for correct responses. Data were compared with point-to-point correspondence for each comprehension question. Inter-scorer agreement, or ISA, was calculated by dividing the total number of agreement intervals by the total number of intervals in the session and multiplying by 100 (Cooper et al. 2007). Inter-scorer agreement for the pre-and post-intervention comprehension probes is displayed in Table 15.

Table 15.

Inter-Scorer Agreement For Pre-Post Intervention Comprehension Probe Sessions.

<i>Participant</i>	<i>Pre- Intervention Sessions</i>	<i>Mean Agreement</i>	<i>Range</i>	<i>Post- Intervention Sessions</i>	<i>Mean Agreement</i>	<i>Range</i>
Participant A	100%	76%	35%- 100%	100%	82%	65%- 94%
Participant B	100%	86%	67%- 95%	100%	91%	83%- 100%
Participant C	100%	91%	80%- 100%	100%	99%	95%- 100%
Participant D	100%	84%	70%- 100%	100%	91%	88%- 100%
Participant E	100%	92%	77%- 100%	100%	100%	100%
Participant F	100%	96.3%	77%- 100%	100%	94.5%	90%- 100%

Pre-and post-intervention naming probes. Inter-observer agreement was calculated for 100% of pre- and post-intervention probe sessions for all participants. An independent observer

watched the experimenter deliver the naming probes and independently collected data on each response. Observers were instructed to mark a minus (-) for incorrect responses and a plus (+) for correct responses. Data were compared with point-to-point correspondence for each interval. Inter-observer agreement, or IOA, was calculated by dividing the total number of agreement intervals by the total number of intervals in the session and multiplying by 100 (Cooper et al. 2007). Inter-observer agreement for the pre-and post-intervention comprehension probes is displayed in Table 16.

Table 16.

<i>Inter-Observer Agreement For Pre-Post Intervention Naming Probe Sessions.</i>						
<i>Participant</i>	<i>Pre- Intervention Sessions</i>	<i>Mean Agreement</i>	<i>Range</i>	<i>Post- Intervention Sessions</i>	<i>Mean Agreement</i>	<i>Range</i>
Participant A	100%	100%	100%	100%	100%	100%
Participant B	100%	100%	100%	100%	100%	100%
Participant C	100%	100%	100%	100%	100%	100%
Participant D	100%	100%	100%	100%	100%	100%
Participant E	100%	100%	100%	100%	100%	100%
Participant F	100%	100%	100%	100%	100%	100%

Pre-and post-intervention drawing probes. Inter-scorer agreement was calculated for 100% of pre- and post-intervention probe sessions for all participants. An independent scorer compared the participant's drawing with sample stimuli. Scorers were instructed to mark a minus (-) for incorrect responses and a plus (+) for correct responses. Data were compared with

point-to-point correspondence for each component drawn. Inter-scorer agreement, or ISA, was calculated by dividing the total number of agreement intervals by the total number of intervals in the session and multiplying by 100 (Cooper et al. 2007). Inter-scorer agreement for the pre-and post-intervention comprehension probes is displayed in Table 17.

Table 17.

Inter-Scorer Agreement For Pre-Post Intervention Drawing Probe Sessions.

<i>Participant</i>	<i>Pre- Intervention Sessions</i>	<i>Mean Agreement</i>	<i>Range</i>	<i>Post- Intervention Sessions</i>	<i>Mean Agreement</i>	<i>Range</i>
Participant A	100%	100%	100%	100%	100%	100%
Participant B	100%	100%	100%	100%	100%	100%
Participant C	100%	93%	80%- 100%	100%	100%	100%
Participant D	100%	93%	80%- 100%	100%	100%	100%
Participant E	100%	100%	100%	100%	100%	100%
Participant F	100%	100%	100%	100%	100%	100%

Intervention comprehension questions. Inter-scorer agreement was calculated for 51% of intervention sessions across all participants. An independent scorer read each story and scored the explicit comprehension questions. Scorers were instructed to mark a minus (-) for incorrect responses, .5 for partially correct responses, and a plus (+) for correct responses. Data were compared with point-to-point correspondence for each comprehension question. Inter-scorer agreement, or ISA, was calculated by dividing the total number of agreement intervals by the total number of intervals in the session and multiplying by 100 (Cooper et al. 2007). Inter-scorer agreement for the pre-and post-intervention comprehension probes is displayed in Table 18.

Table 18.

Inter-Scorer Agreement For Intervention Comprehension Questions.

<i>Participant</i>	<i>Intervention</i>	<i>Mean Agreement</i>	<i>Range</i>
Participant A	43%	92%	88%-100%
Participant B	50%	95%	90%-100%
Participant C	50%	94%	88%-100%
Participant D	60%	96%	89%-100%
Participant E	40%	96%	90%-100%
Participant F	75%	100%	100%

Results

Reading Comprehension Probes

Prior to the intervention, Participant A emitted 22.2% and 11.1% correct responses to texts without pictures present (Figure 8.). Following the intervention, Participant A emitted 65% correct responses to texts without pictures present (Figure 8.). During the follow-up probe, Participant A emitted 83.3% correct responses to a text without pictures present (Figure 8.).

Prior to the intervention, Participant B emitted 38.9% and 44.4% correct responses to texts without pictures present (Figure 8.). Following the intervention, Participant B emitted 88.9% and 77.8% correct responses to texts without pictures present (Figure 8.). During the follow-up probe, Participant B emitted 83.3% correct responses to a text without pictures present (Figure 8.).

Prior to the intervention, Participant C emitted 57.1%, 28.78%, 60%, 60%, and 66.7% correct responses to text without pictures present (Figure 8.). Following the intervention,

Participant C emitted 94.4% and 88.9% correct responses to text without pictures present (Figure 8.). During the follow-up probe, Participant C emitted 90% correct responses to a text without pictures present (Figure 8.).

Prior to the intervention, Participant D emitted 42.9%, 0%, 50%, 61.1%, and 55% correct responses to text without pictures present (Figure 8.). Following the intervention, Participant D emitted 83.3% and 100% correct responses to text without pictures present (Figure 8.). During the follow-up probe, Participant D emitted 83.3% correct responses to a text without pictures present (Figure 8.).

Prior to the intervention, Participant E emitted 21.43%, 50%, 50%, 40%, and 27.78% correct responses to text without pictures present (Figure 8.). Following the intervention, Participant E emitted 75% and 88.89% correct responses to text without pictures present (Figure 8.).

Prior to the intervention, Participant F emitted 0%, 0%, 33.33%, 61.1%, and 55.56% correct responses to text without pictures present (Figure 8.). Following the intervention, Participant F emitted 90% and 83.33% correct responses to text without pictures present (Figure 8.).

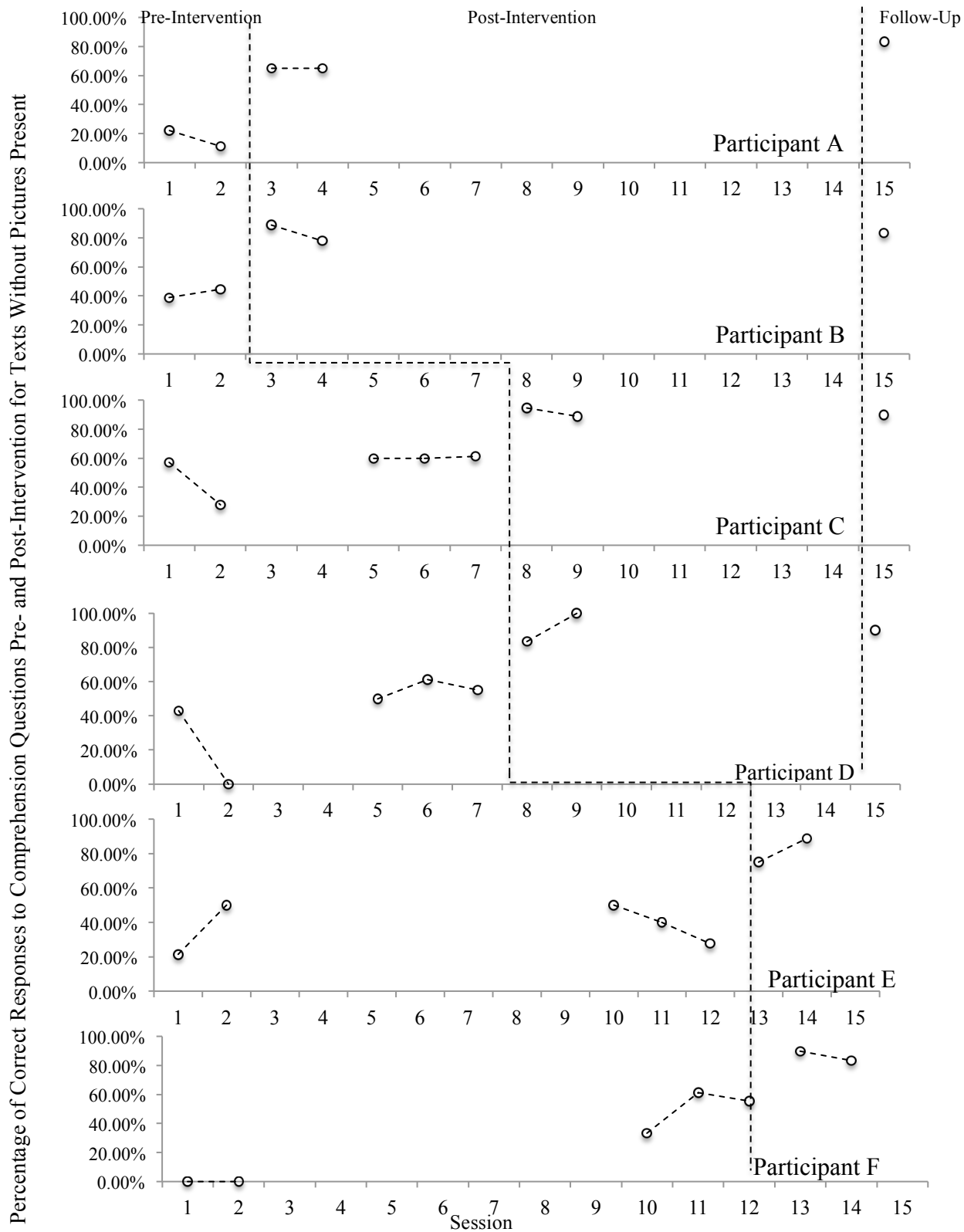


Figure 8. represents the percentage of correct responses to comprehension questions for all participants pre-and post-intervention.

Prior to the onset of the intervention, Participant A emitted a mean of 59.64% correct responses to comprehension questions for texts with pictures present, and a mean of 16.67% correct responses to comprehension questions for texts without pictures present (Figure 9.). Following the intervention, Participant A emitted a mean of 77.78% correct responses to comprehension questions for texts with pictures present and a mean of 65% correct responses to comprehension questions for texts without pictures present (Figure 9.)

Prior to the onset of the intervention, Participant B emitted a mean of 70.36% correct responses to comprehension questions for texts with pictures present, and a mean of 41.67% correct responses to comprehension questions for texts without pictures present (Figure 9.). Following the intervention, Participant B emitted a mean of 67.50% correct responses to comprehension questions for texts with pictures present and a mean of 83.33% correct responses to comprehension questions for texts without pictures present (Figure 9.)

During the initial pre-intervention probe session, Participant C emitted a mean of 58.33% correct responses to comprehension questions for texts with pictures present, and a mean of 42.46% correct responses to comprehension questions for texts without pictures present (Figure 9.). During the second pre-intervention probe session, Participant C emitted a mean of 66.3% correct responses to comprehension questions for texts with pictures present, and a mean of 60.37% correct responses to comprehension questions for texts without pictures present (Figure 9.). Following the intervention, Participant C emitted a mean of 94.44% correct responses to comprehension questions for texts with pictures present and a mean of 91.67% correct responses to comprehension questions for texts without pictures present (Figure 9.)

During the initial pre-intervention probe session, Participant D emitted a mean of 55.56% correct responses to comprehension questions for texts with pictures present, and a mean of

21.43% correct responses to comprehension questions for texts without pictures present (Figure 9.). During the second pre-intervention probe session, Participant D emitted a mean of 62.41% correct responses to comprehension questions for texts with pictures present, and a mean of 55.37% correct responses to comprehension questions for texts without pictures present (Figure 9.). Following the intervention, Participant D emitted a mean of 97.22% correct responses to comprehension questions for texts with pictures present and a mean of 91.67% correct responses to comprehension questions for texts without pictures present (Figure 9.)

During the initial pre-intervention probe session, Participant E emitted a mean of 30.56% correct responses to comprehension questions for texts with pictures present, and a mean of 35.71% correct responses to comprehension questions for texts without pictures present (Figure 9.). During the second pre-intervention probe session, Participant E emitted a mean of 74.04% correct responses to comprehension questions for texts with pictures present, and a mean of 39.26% correct responses to comprehension questions for texts without pictures present (Figure 9.). Following the intervention, Participant E emitted a mean of 76.39% correct responses to comprehension questions for texts with pictures present and a mean of 81.94% correct responses to comprehension questions for texts without pictures present (Figure 9.)

During the initial pre-intervention probe session, Participant F emitted a mean of 63.21% correct responses to comprehension questions for texts with pictures present, and a mean of 0% correct responses to comprehension questions for texts without pictures present (Figure 9.). During the second pre-intervention probe session, Participant F emitted a mean of 65.41% correct responses to comprehension questions for texts with pictures present, and a mean of 50% correct responses to comprehension questions for texts without pictures present (Figure 9.). Following the intervention, Participant F emitted a mean of 94.44% correct responses to

comprehension questions for texts with pictures present and a mean of 86.67% correct responses to comprehension questions for texts without pictures present (Figure 9.)

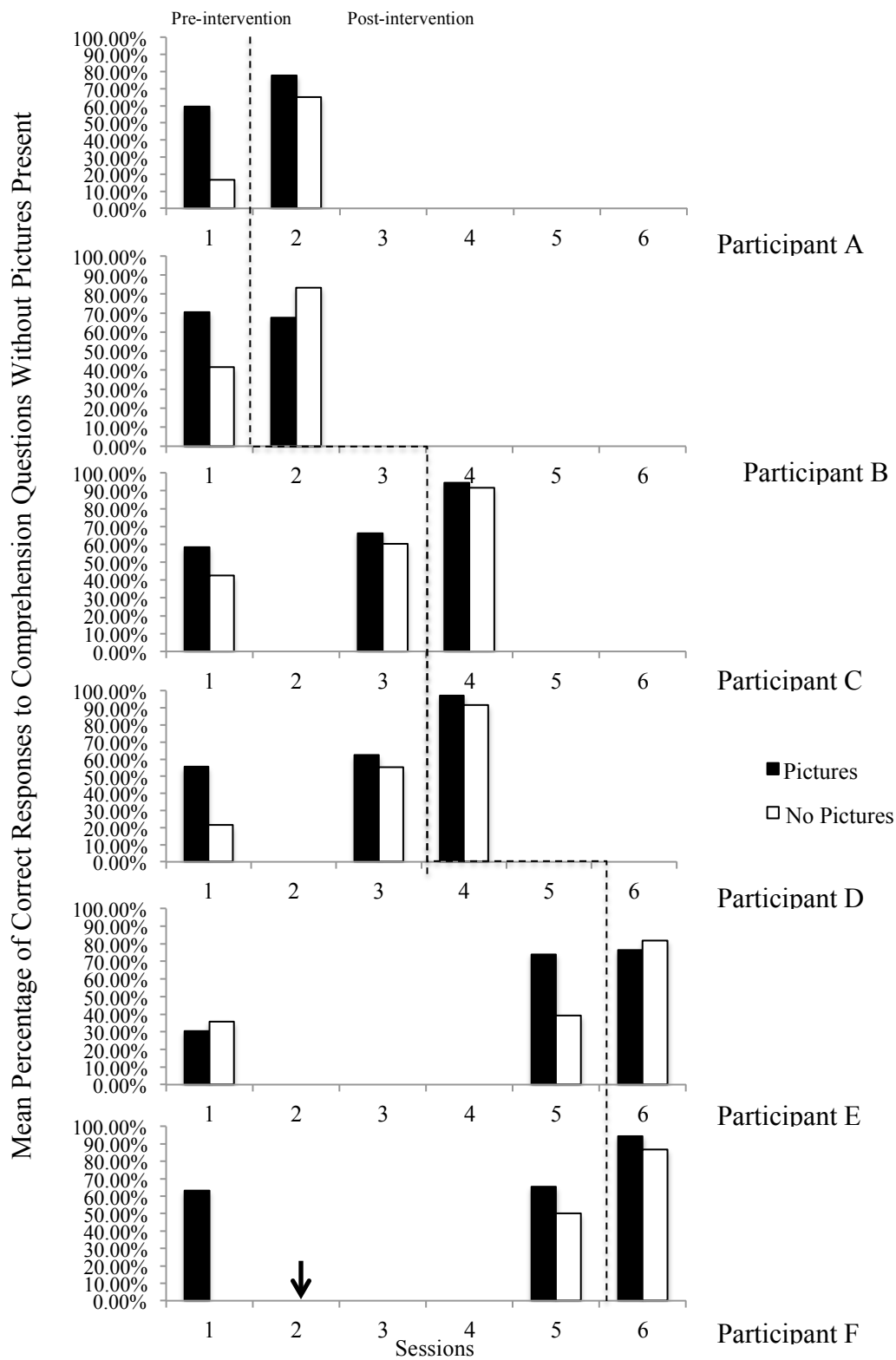


Figure 9. represents the mean percentage of correct responses to comprehension questions for all participants pre-and post-intervention.

Contrived Naming Probes

Prior to the onset of the intervention, Participant A emitted 70% correct responding to the point-to topography, 20% correct responding to the tact topography, and 10% correct responding to the intraverbal topography (Figure 10.). Following the intervention, Participant A emitted 50% correct responding to the point-to topography, 20% correct responding to the tact topography, and 50% correct responding to the intraverbal topography (Figure 10.).

Prior to the onset of the intervention, Participant B emitted 50% correct responding to the point-to topography, 60% correct responding to the tact topography, and 60% correct responding to the intraverbal topography (Figure 10.). Following the intervention, Participant B emitted 100% correct responding to the point-to topography, 100% correct responding to the tact topography, and 100% correct responding to the intraverbal topography (Figure 10.). During the novel probe, Participant B emitted 70% correct responding to the point-to topography, 20% correct responding to the tact topography, and 40% correct responding to the intraverbal topography (Figure 10.).

During the initial pre-intervention probe, Participant C emitted 90% correct responding to the point-to topography, 60% correct responding to the tact topography, and 60% correct responding to the intraverbal topography (Figure 10.). During the second pre-intervention probe, Participant C emitted 80% correct responding to the point-to topography, 80% correct responding to the tact topography, and 80% correct responding to the intraverbal topography (Figure 10.). During the novel probe, Participant C emitted 100% correct responding to the point-to topography, 90% correct responding to the tact topography, and 100% correct responding to the intraverbal topography (Figure 10.). Following the intervention, Participant C emitted 100% correct responding to the point-to topography, 80% correct responding to the tact topography, and 90% correct responding to the intraverbal topography (Figure 10.).

During the initial pre-intervention probe, Participant D emitted 80% correct responding to the point-to topography, 10% correct responding to the tact topography, 0% correct responding to the intraverbal topography, and 0% correct responding to the drawing topography (Figure 10.). During the second pre-intervention probe, Participant D emitted 10% correct responding to the point-to topography, 50% correct responding to the tact topography, 60% correct responding to the intraverbal topography, and 20% correct responding to the drawing topography (Figure 10.). During the third pre-intervention probe, Participant D emitted 100% correct responding to the point-to topography, 100% correct responding to the tact topography, 100% correct responding to the intraverbal topography, and 80% correct responding to the drawing topography (Figure 10.). During the novel probe, Participant D emitted 80% correct responding to the point-to topography, 0% correct responding to the tact topography, 0% correct responding to the intraverbal topography, and 40% correct responding to the drawing topography (Figure 10.). Following the intervention, Participant D emitted 80% correct responding to the point-to topography, 50% correct responding to the tact topography, 60% correct responding to the intraverbal topography, and 80% correct responding to the drawing topography (Figure 10.).

During the initial pre-intervention probe, Participant E emitted 50% correct responding to the point-to topography, 50% correct responding to the tact topography, 60% correct responding to the intraverbal topography, and 60% correct responding to the drawing topography (Figure 10.). During the second pre-intervention probe, Participant E emitted 50% correct responding to the point-to topography, 30% correct responding to the tact topography, and 50% correct responding to the intraverbal topography (Figure 10.). Following the intervention, Participant E emitted 100% correct responding to the point-to topography, 60% correct responding to the tact topography, and 50% correct responding to the intraverbal topography (Figure 10.).

During the initial pre-intervention probe, Participant F emitted 80% correct responding to the point-to topography, 30% correct responding to the tact topography, and 20% correct responding to the intraverbal topography (Figure 10.). During the second pre-intervention probe, Participant F emitted 80% correct responding to the point-to topography, 60% correct responding to the tact topography, and 60% correct responding to the intraverbal topography (Figure 10.). During the third pre-intervention probe, Participant F emitted 100% correct responding to the point-to topography, 100% correct responding to the tact topography, and 100% correct responding to the intraverbal topography (Figure 10.). During the novel probe, Participant F emitted 90% correct responding to the point-to topography, 20% correct responding to the tact topography, and 20% correct responding to the intraverbal topography (Figure 10.). Following the intervention, Participant F emitted 90% correct responding to the point-to topography, 80% correct responding to the tact topography, and 80% correct responding to the intraverbal topography (Figure 10.). Given a novel probe, Participant F Emitted 100% correct responding to the point-to topography, 90% correct responding to the tact topography, and 80% correct responding to the intraverbal topography (Figure 10.).

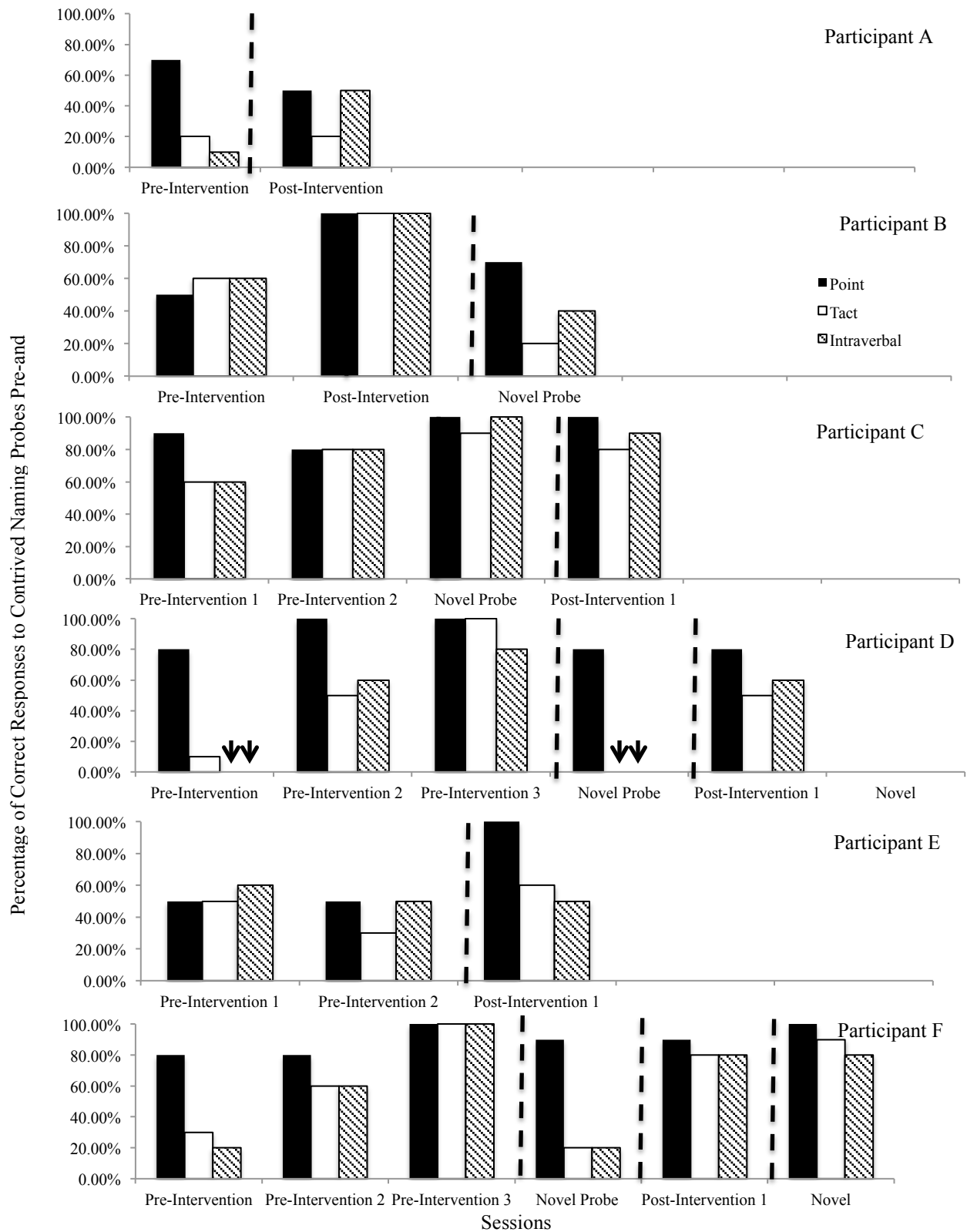


Figure 10. represents the percentage of correct responses to contrived naming probes for all participants pre-and post-intervention.

Drawing Responses (Conditioned Seeing)

Prior to the onset of the intervention, Participant A emitted 40% correct responses to the drawing topography (Figure 11.). Following the intervention, Participant A emitted 60% correct responses to the drawing topography (Figure 11.).

Prior to the onset of the intervention, Participant B emitted 40% correct responses to the drawing topography (Figure 11.). Following the intervention, Participant B emitted 60% correct responses to the drawing topography (Figure 11.). Given a novel probe, Participant B emitted 60% correct responses to the drawing topography (Figure 11.).

Prior to the onset of the intervention, Participant C emitted 60% correct responses to the drawing topography (Figure 11.). During the second pre-intervention probe, Participant C emitted 80% correct responses to the drawing topography (Figure 11.). Given a novel probe, Participant C emitted 60% correct responses to the drawing topography (Figure 11.). Following the intervention, Participant C emitted 80% correct responses to the drawing topography (Figure 11.).

Prior to the onset of the intervention, Participant D emitted 0% correct responses to the drawing topography (Figure 11.). During the second pre-intervention probe, Participant D emitted 20% correct responses to the drawing topography (Figure 11.). During the third pre-intervention probe, Participant D emitted 80% correct responses to the drawing topography. Given a novel probe, Participant D emitted 40% correct responses to the drawing topography (Figure 11.). Following the intervention, Participant D emitted 80% correct responses to the drawing topography (Figure 11.).

Prior to the onset of the intervention, Participant E emitted 60% correct responses to the drawing topography (Figure 11.). During the second pre-intervention probe, Participant E

emitted 40% correct responses to the drawing topography (Figure 11.). Following the intervention, Participant E emitted 80% correct responses to the drawing topography (Figure 11.).

Prior to the onset of the intervention, Participant F emitted 20% correct responses to the drawing topography (Figure 11.). During the second pre-intervention probe, Participant F emitted 60% correct responses to the drawing topography (Figure 11.). During the third pre-intervention probe, Participant F emitted 60% correct responses to the drawing topography. Given a novel probe, Participant F emitted 60% correct responses to the drawing topography (Figure 11.). Following the intervention, Participant F emitted 100% correct responses to the drawing topography for both the post-intervention probe set, and a novel probe (Figure 11.).

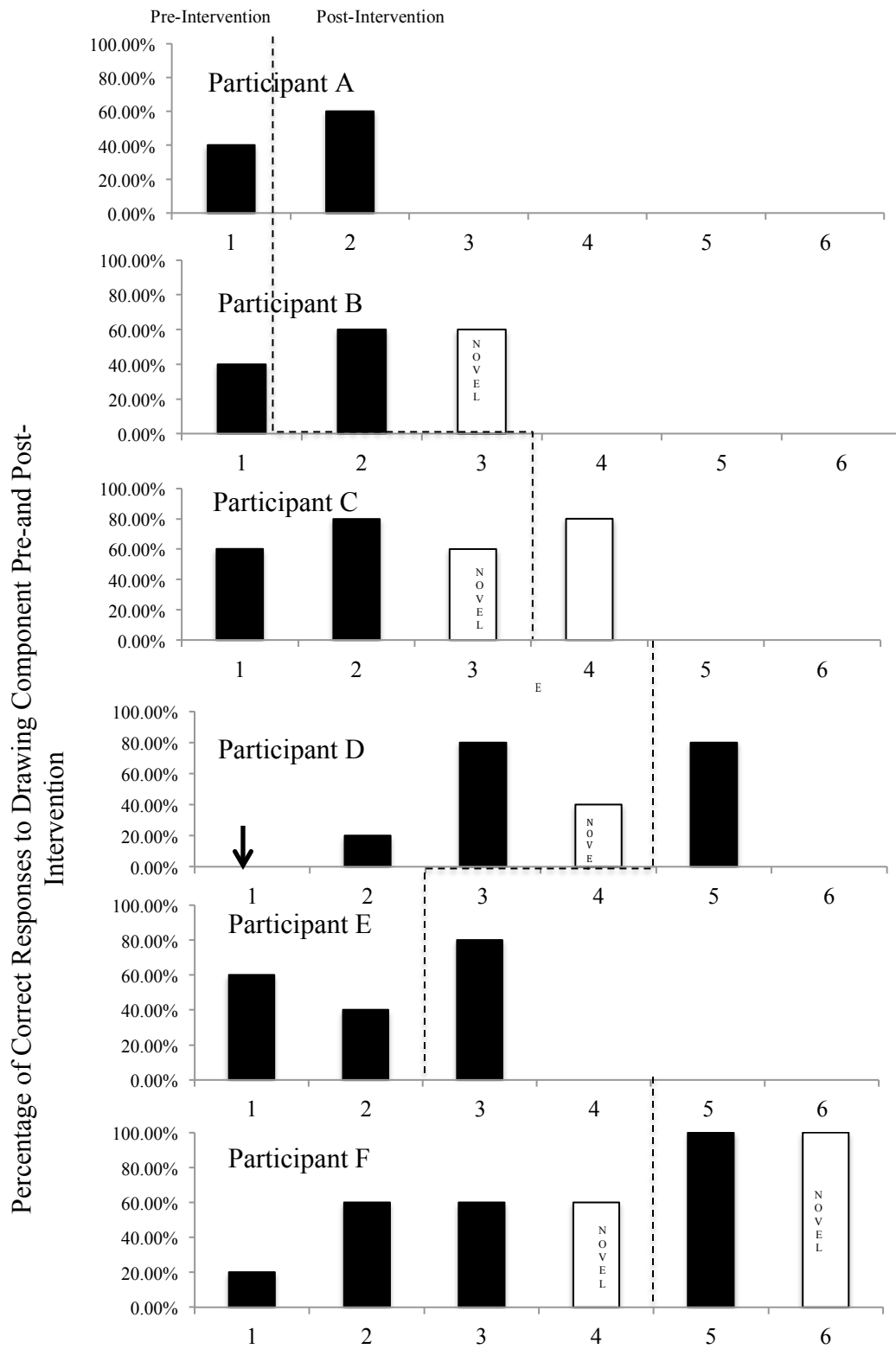


Figure 11. represents the percentage of correct responses to pre-and post-intervention drawing probes for all participants.

Intervention Results

Comprehension questions. During the intervention, Participant A emitted 66.67% correct responses to comprehension questions during the first session, 55.56% correct responses to comprehension questions during the second session, 40% correct responses during the third session, 61.11% correct responses during the fourth session, 77.78% correct responses during the fifth session, and 100% correct responses during the sixth and seventh sessions respectively (Figure 12.). Following 90% correct responding across two consecutive sessions, the intervention was complete.

During the intervention, Participant B emitted 55.56% correct responses to comprehension questions during the first session, 66.67% correct responses to comprehension questions during the second session, 94.44% correct responses during the third session, and 95% correct responses during the fourth session (Figure 12.). Following 90% correct responding across two consecutive sessions, the intervention was complete.

During the intervention, Participant C emitted 77.78% correct responses to comprehension questions during the first session, 88.89% correct responses to comprehension questions during the second session, 100% correct responses during the third session, and 94.44% correct responses during the fourth session (Figure 12.). Following 90% correct responding across two consecutive sessions, the intervention was complete.

During the intervention, Participant D emitted 65% correct responses to comprehension questions during the first session, 72.22% correct responses to comprehension questions during the second session, 90% correct responses during the third session, 95% correct responses during the fourth session, and 94.44% correct responses during the fifth session (Figure 12). Following 90% correct responding across two consecutive sessions, the intervention was complete.

During the intervention, Participant E emitted 61.11% correct responses to comprehension questions during the first session, 94.44% correct responses to comprehension questions during the second session, 66.67% correct responses during the third session, 88.89% correct responses during the fourth session, 70% correct responses during the fifth session, 85% correct responses during the sixth session, 95% correct responses during the seventh session, 80% correct responses during the eighth session, 70% correct responses during the ninth session, and 65% correct responses during the tenth session (Figure 12.). Following 10 intervention sessions, with a descending trend across the last three sessions, the intervention was terminated for Participant E.

During the intervention, Participant F emitted 90% correct responses to comprehension questions during the first session, 76.60% correct responses to comprehension questions during the second session, 90% correct responses during the third session, and 100% correct responses during the fourth session (Figure 12.). Following 90% correct responding across two consecutive sessions, the intervention was complete.

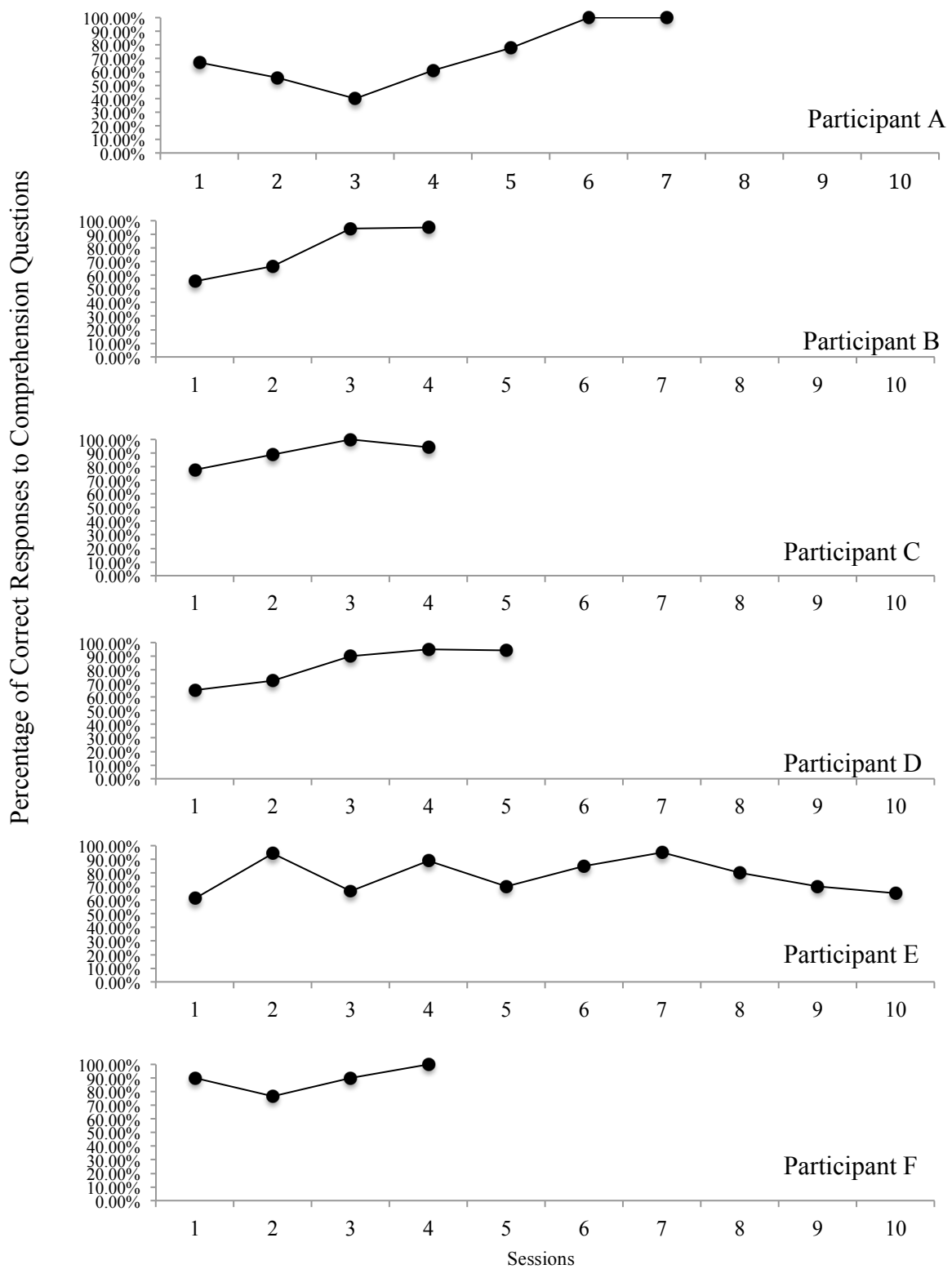


Figure 12. represents the percentage of correct responses to comprehension questions for all participants during the intervention.

Storyboard components. During the intervention, Participant A created 83.33% correct components of the storyboard during the first session, 72.73% correct components of the storyboard during the second session, 88.89% correct components during the third session, 100% correct components during the fourth session, 87.5% correct components during the fifth session, 100% correct components during the sixth session, and 87.5% correct components during the seventh session (Figure 13.).

During the intervention, Participant B created 54.54% correct components of the storyboard during the first session, 83.33% correct components of the storyboard during the second session, 100% correct components during the third session, and 55.56% correct components during the fourth session (Figure 13.).

During the intervention, Participant C created 62.5% correct components of the storyboard during the first session, 72.73% correct components of the storyboard during the second session, 87.5% correct components during the third session, and 77.78% correct components during the fourth session (Figure 13.).

During the intervention, Participant D created 100% correct components of the storyboard during the first session, 75% correct components of the storyboard during the second session, 85.71% correct components during the third session, 87.5% correct responses during the fourth session, and 77.78% correct components during the fifth session (Figure 13.).

During the intervention, Participant E created 66.67% correct components of the storyboard during the first session, 100% correct components of the storyboard during the second session, 77.78% correct components during the third session, 100% correct responses during the fourth session, 57.14% correct components during the fifth session, 77.78% correct responses during the sixth session, 50% correct responses during the seventh session, 88.89% correct

responses during the eighth session, 72.73% correct responses during the ninth session, and 77.78% correct responses during the tenth session (Figure 13.).

During the intervention, Participant F created 88.89% correct components of the storyboard during the first session, 75% correct components of the storyboard during the second session, 100% correct components during the third session, and 87.5% correct components during the fourth session (Figure 13.).

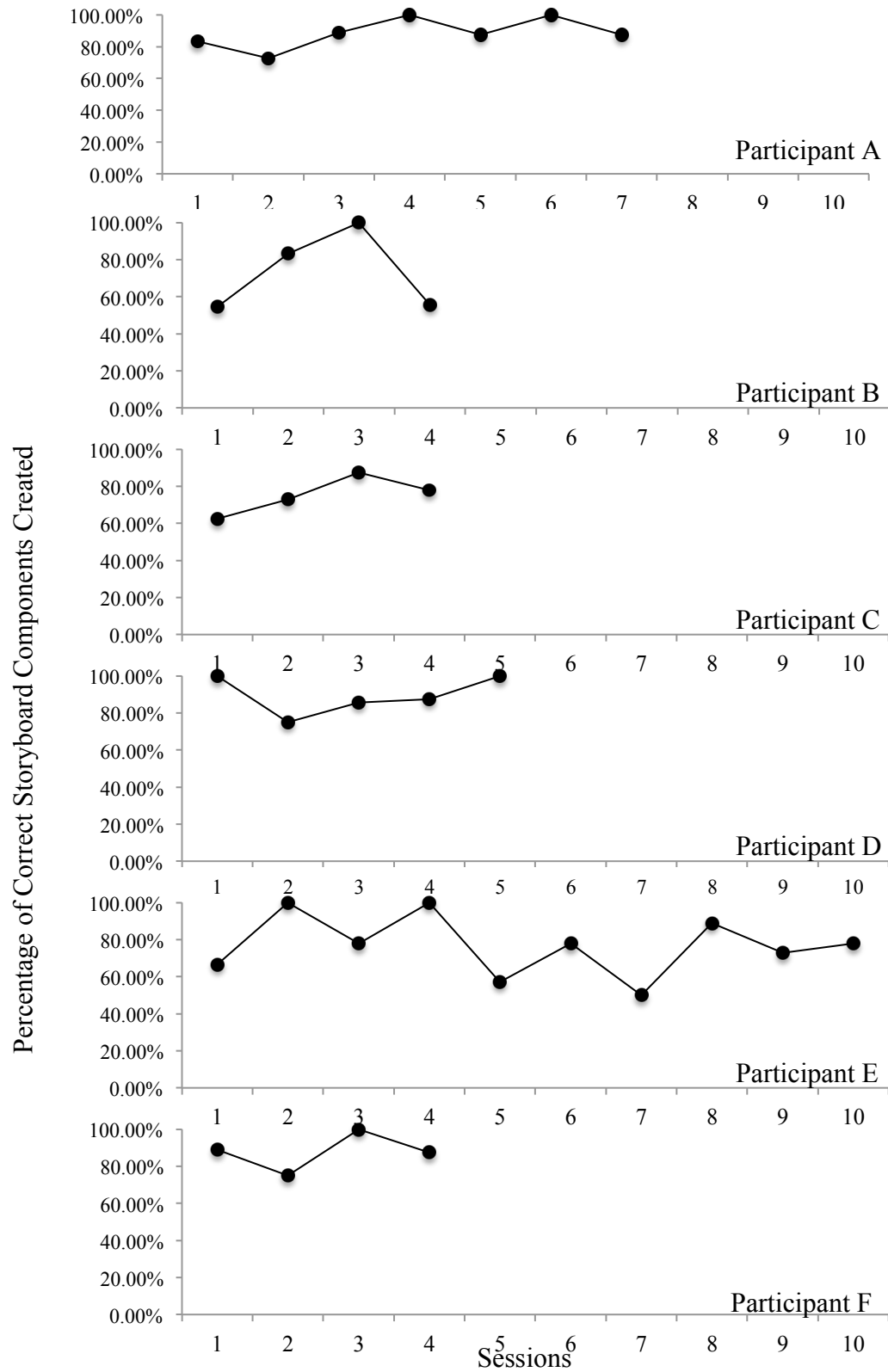


Figure 13. represents the percentage of correct storyboard components created during intervention sessions.

Discussion

Comprehension Without Pictures Present

The results of the present study demonstrate the effectiveness of the storyboard intervention on increasing comprehension for texts without pictures present for students who are performing below grade-level in reading. Prior to the intervention, Participant A emitted a mean of 16.67% correct responses to comprehension questions without pictures present. Following the storyboard intervention, Participant A emitted a mean of 65% correct responses to comprehension questions without pictures present, which is a 48.33% increase (Table 19). Prior to the intervention, Participant B emitted a mean of 41.67% correct responses to comprehension questions without pictures present. Following the storyboard intervention, Participant B emitted a mean of 83.33% correct responses to comprehension questions without pictures present, which is a 41.66% increase (Table 19). Prior to the intervention, Participant C emitted a mean of 60.37% correct responses to comprehension questions without pictures present. Following the storyboard intervention, Participant C emitted a mean of 91.67% correct responses to comprehension questions without pictures present, which is a 31.3% increase (Table 19). Prior to the intervention, Participant D emitted a mean of 55.37% correct responses to comprehension questions without pictures present. Following the storyboard intervention, Participant D emitted a mean of 91.67% correct responses to comprehension questions without pictures present, which is a 36.3% increase (Table 19). Prior to the intervention, Participant E emitted a mean of 39.62% correct responses to comprehension questions without pictures present. Following the storyboard intervention, Participant E emitted a mean of 81.94% correct responses to comprehension questions without pictures present, which is a 42.69% increase (Table 19). Prior to the intervention, Participant F emitted a mean of 50% correct responses to comprehension questions without pictures present. Following the storyboard intervention, Participant F emitted

a mean of 86.67% correct responses to comprehension questions without pictures present, which is a 36.67% increase (Table 19). Figure 14. displays the increases in comprehension for texts without pictures present pre-to post-intervention.

Table 19.

<i>Mean Differences in Comprehension Scores Without Pictures Pre- and Post-Intervention.</i>			
<i>Participant</i>	<i>Pre-Intervention Mean Comprehension Scores</i>	<i>Post-Intervention Mean Comprehension Scores</i>	<i>Mean Difference Pre-Post Intervention</i>
Participant A	16.67%	65%	48.33%
Participant B	41.67%	83.33%	41.66%
Participant C	60.37%	91.67%	31.3%
Participant D	55.37%	91.67%	36.3%
Participant E	39.26%	81.84%	42.69%
Participant F	50.00%	86.67%	36.67%

Note: Increases in comprehension pre-to post-intervention were calculated by subtracting the pre-intervention mean scores without pictures from the post-intervention scores without pictures.

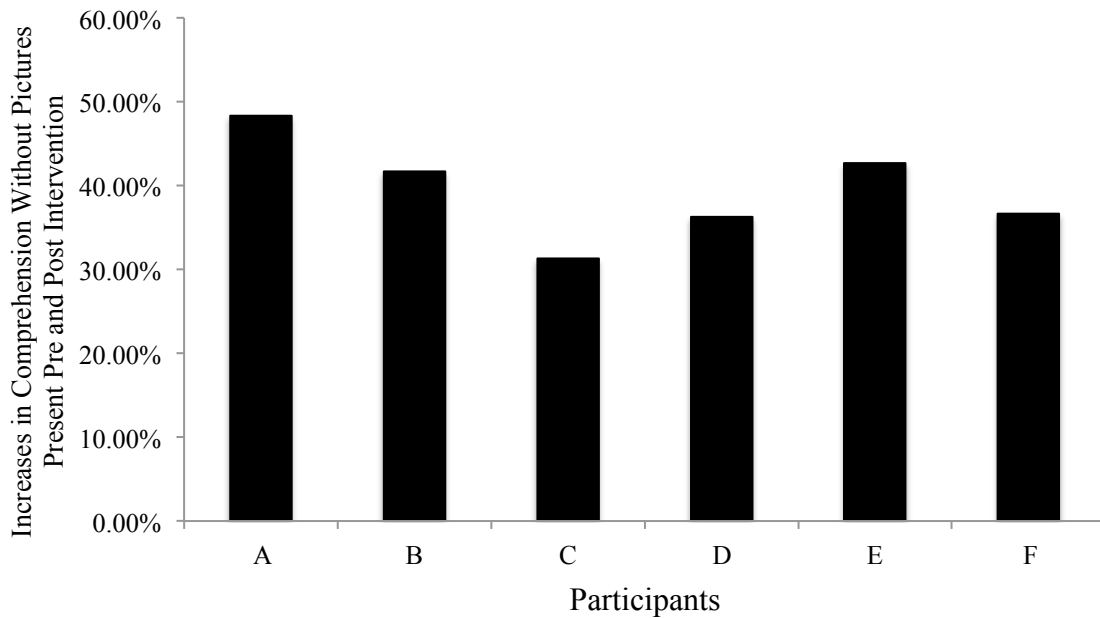


Figure 14. Represents the increases in comprehension scores without pictures present pre-to post-intervention for all participants.

Comprehension With Pictures Present

The results of the present study also demonstrate the effectiveness of the storyboard intervention on increasing comprehension for texts with pictures present for students performing below grade-level in reading. Results showed an increase in comprehension for texts with pictures present for all but one participant. Prior to the intervention, Participant A emitted a mean of 59.64% correct responses to comprehension questions with pictures present. Following the storyboard intervention, Participant A emitted a mean of 77.78% correct responses to comprehension questions with pictures present, which is a 18.13% increase (Table 20). Prior to the intervention, Participant B emitted a mean of 70.36% correct responses to comprehension questions with pictures present. Following the storyboard intervention, Participant B emitted a mean of 67.50% correct responses to comprehension questions with pictures present, which is a 2.86% decrease (Table 20). Prior to the intervention, Participant C emitted a mean of 66.30% correct responses to comprehension questions with pictures present. Following the storyboard

intervention, Participant C emitted a mean of 94.44% correct responses to comprehension questions with pictures present, which is a 28.15% increase (Table 20). Prior to the intervention, Participant D emitted a mean of 62.41% correct responses to comprehension questions with pictures present. Following the storyboard intervention, Participant D emitted a mean of 97.22% correct responses to comprehension questions with pictures present, which is a 34.81% increase (Table 20). Prior to the intervention, Participant E emitted a mean of 74.07% correct responses to comprehension questions with pictures present. Following the storyboard intervention, Participant E emitted a mean of 76.39% correct responses to comprehension questions with pictures present, which is a 2.31% increase (Table 20). Prior to the intervention, Participant F emitted a mean of 65.41% correct responses to comprehension questions with pictures present. Following the storyboard intervention, Participant F emitted a mean of 94.44% correct responses to comprehension questions with pictures present, which is a 29.04% increase (Table 20). Figure 15. displays the increases in comprehension for texts without pictures present pre-to post-intervention.

Table 20.

<i>Mean Differences in Comprehension Scores With Pictures Pre- and Post-Intervention.</i>			
<i>Participant</i>	<i>Pre-Intervention Mean Comprehension Scores</i>	<i>Post-Intervention Mean Comprehension Scores</i>	<i>Mean Difference Pre-Post Intervention</i>
Participant A	59.64%	77.78%	18.13%
Participant B	70.36%	67.50%	-2.86%
Participant C	66.30%	94.44%	28.15%
Participant D	62.41%	97.22%	34.81%
Participant E	74.07%	76.39%	2.31%
Participant F	65.41%	94.44%	29.04%

Note: Increases in comprehension pre-to post-intervention were calculated by subtracting the pre-intervention mean scores without pictures from the post-intervention scores without pictures.

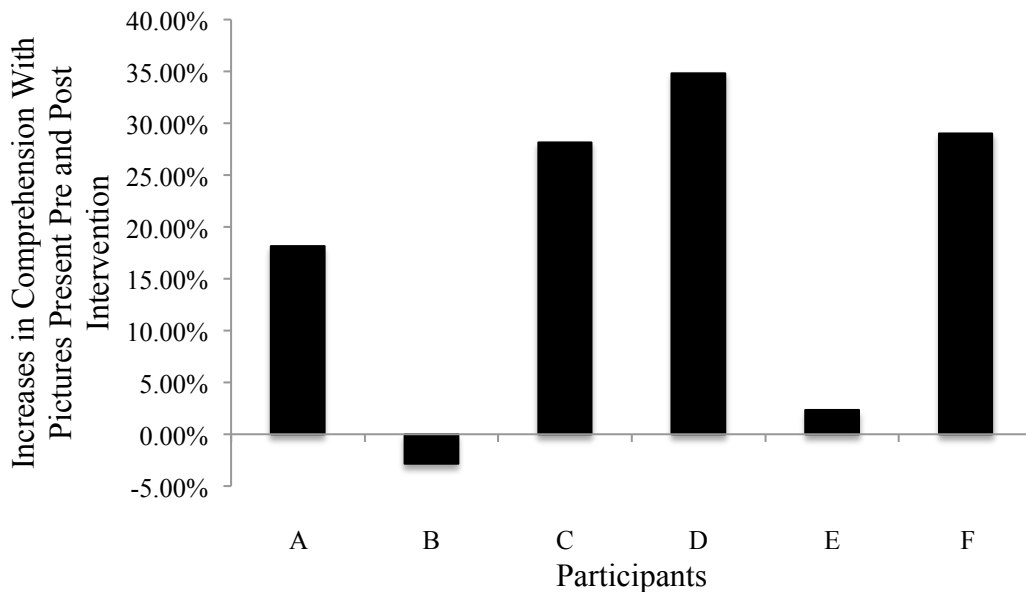


Figure 15. Represents the increases in comprehension scores with pictures present pre-to post-intervention for all participants.

Following the storyboard intervention, the mean difference between comprehension for texts with and without pictures present decreased for all participants. Prior to the intervention, there was a 42.98% difference in comprehension for texts with and without pictures for Participant A (Figure 16.). Following the intervention, there was a 12.78% difference in comprehension for texts with and without pictures present for Participant A (Figure 16.). Prior to the intervention, there was a 28.69% difference in comprehension for texts with and without pictures for Participant B (Figure 16.). Following the intervention, there was a 15.83% difference in comprehension for texts with and without pictures present for Participant B (Figure 16.). Prior to the intervention, there was a 5.93% difference in comprehension for texts with and without pictures for Participant C (Figure 16.). Following the intervention, there was a 2.78% difference in comprehension for texts with and without pictures present for Participant C (Figure 16.). Prior to the intervention, there was a 7.04% difference in comprehension for texts with and without pictures for Participant D (Figure 16.). Following the intervention, there was a 5.56% difference in comprehension for texts with and without pictures present for Participant D (Figure 16.). Prior to the intervention, there was a 34.81% difference in comprehension for texts with and without pictures for Participant E (Figure 16.). Following the intervention, there was a -5.56% difference in comprehension for texts with and without pictures present for Participant E (Figure 16.). Prior to the intervention, there was a 15.41% difference in comprehension for texts with and without pictures for Participant F (Figure 16.). Following the intervention, there was a 7.78% difference in comprehension for texts with and without pictures present for Participant F (Figure 16.).

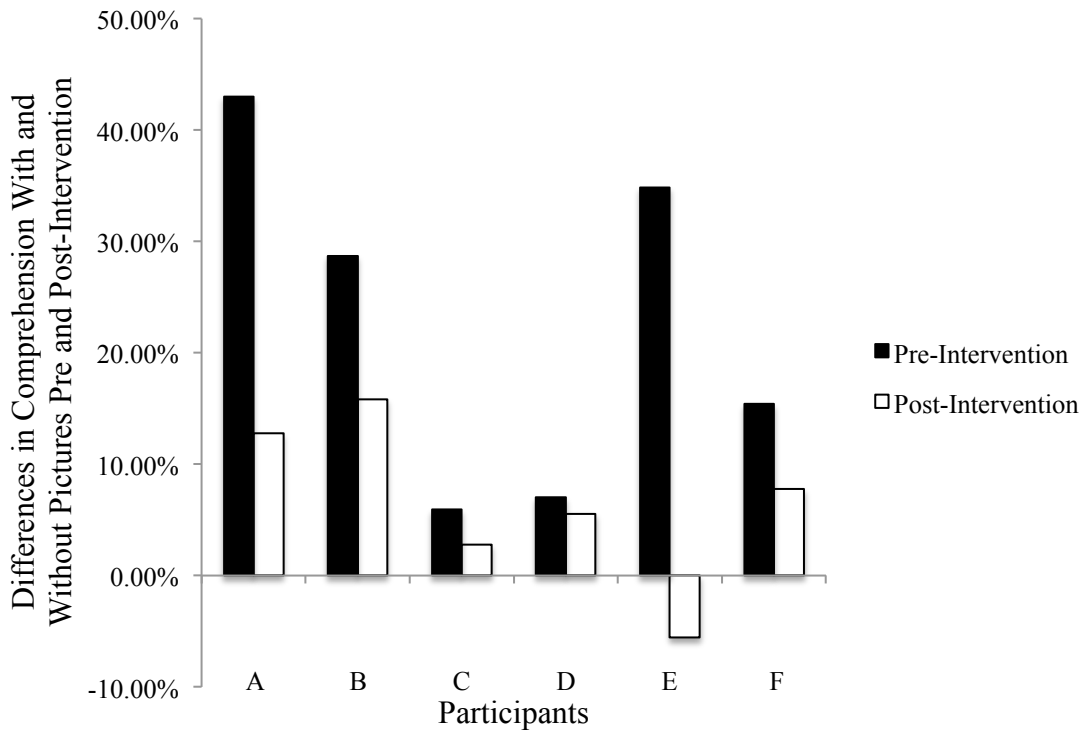


Figure 16. represents the difference in comprehension scores for with and without pictures condition pre-and post-intervention for all participants.

Naming

Following the intervention Participant A emitted an increased number of correct responses to the speaker components of naming; however, the listener component of naming decreased. Following the intervention, Participant B acquired full naming for the initial set of stimuli, but did not demonstrate full naming during a novel probe set. Participant C acquired full naming prior to the intervention, and consistently demonstrated the naming repertoire across the following novel probe sets. Following the intervention, Participant D demonstrated the listener component of naming, and her data post-intervention were consistent with her performance following her prior second exposure to a contrived naming set. Prior to the intervention, Participant E did not demonstrate the speaker or listener components of naming. Following the intervention, Participant E acquired the listener component of naming. Prior to the intervention,

Participant F demonstrated full naming following three-exposures to the set of stimuli. Following a novel probe, it was determined that the participant did not have full naming in repertoire for a novel set of stimuli. Following the intervention, Participant F demonstrated full naming during the second exposure to the set. Following a second novel probe, Participant F demonstrated full naming during the first exposure. Prior to the intervention, 1 participant demonstrated the speaker component of naming, 2 participants demonstrated the listener component of naming, and 1 participant demonstrated full naming. Following the intervention, 3 participants demonstrated the speaker component of naming, 5 participants demonstrated the listener component of naming, 2 participants demonstrated full naming following the intervention, and 2 participants demonstrated naming with a novel set of stimuli. Figure 17 shows the percentage of participants with each component of naming pre- and post- intervention.

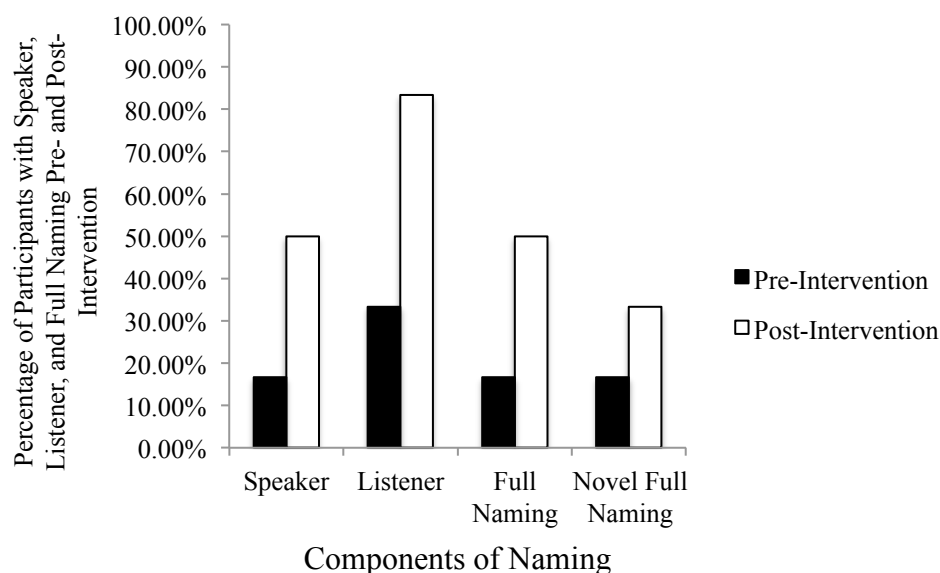


Figure 17. Represents the percentage of participants with the speaker component, listener component, and full naming pre-and post-intervention.

Conditioned Seeing

The results of the present study demonstrated an increase in the presence of the drawing component, or measure of conditioned seeing, which resulted in the emergence of the repertoire in 4 out of the 6 participants. Following the intervention, Participants A & B demonstrated a

20% increase in their responses to the drawing responses; increasing from 40% to 60% correct responses in the post intervention probe. However, neither participant performed at criterion level (80% across one session) for conditioned seeing to be in repertoire. Prior to the intervention both Participants C & D demonstrated the drawing component during the post intervention probes in which they demonstrated full naming, but not during the novel probe. Following the intervention, Participants C & D both demonstrated conditioned seeing during the post intervention probe. Prior to the intervention, Participants E & F did not demonstrate conditioned seeing; however, following the intervention both participants demonstrated conditioned seeing scoring 80% and 100% correct responses respectively. It should be noted that the participants who demonstrated conditioned seeing following the intervention (Participants C, D, E & F) had higher comprehension scores during both the with and without pictures conditions post-intervention than the participants who did not demonstrate conditioned seeing (Participants A & B). It should also be noted that none of the participants demonstrated conditioned seeing with a novel set of stimuli prior to the intervention; however, following the intervention Participants C & F demonstrated conditioned seeing with a novel set of stimuli.

The next chapter will discuss the findings in further detail, as well as limitations, and future research.

Chapter V

General Discussion

In three experiments, I tested for 1) the presence of the naming capability and the participants' drawing responses to the stimuli learned in the absence of the visual stimulus, 2) the differences in below, on and above grade-level students' comprehension of texts with and without pictures present and its relation to the naming and drawing repertoires, and 3) the effects of sequencing and producing components of a narrative story on below grade-level participant's responses to written comprehension questions without pictures present.

In Experiment I, I determined the frequencies of the naming and conditioned seeing repertoires in students performing below, on, and above grade-level for reading. Results demonstrated lower instances of the speaker component of naming and the drawing repertoire in students performing below-grade-level in reading as compared to their on and above grade-level counterparts. Furthermore, I conducted a correlational analysis between the naming capability and 1) free and reduced lunch status and 2) English Language Learner Status. The results of the correlational analysis demonstrated negative correlations between the presence of the naming capability and membership in these two groups. I hypothesized the lack of the naming capability was due to a poor production response repertoire, which includes skills such as speaking, writing, and drawing.

In Experiment II, I sought to determine whether there were differences in comprehension between the below, on, and above grade-level students while reading texts with and without pictures present. Furthermore, I sought to determine whether there was a relation between the speaker component of naming and the comprehension of texts without pictures present, as well as the drawing repertoire and the comprehension of texts without pictures present. The results demonstrated a significant difference in mean comprehension scores between the students

performing below grade-level as compared to their on and above grade-level counterparts. Furthermore, there was a significant difference in comprehension scores during the without pictures condition for students performing on grade-level and their above grade-level counterparts. There was also a significant difference in comprehension scores during the with pictures condition between the students performing below grade-level in reading and their on and above grade-level counterparts. Results also demonstrated a significant correlation between the number of components drawn during the conditioned seeing probes and mean comprehension scores for texts without pictures present; as well as a correlation between comprehension and the speaker component of naming.

The results of Experiment II were consistent with the hypothesis that differences in performance on naming, drawing, and comprehension probes could be due to a poor production response repertoire, which includes skills such as speaking, writing, and drawing. In order to respond correctly to comprehension questions, one must be able to acquire information through reading, and use it to create a production response that matches the written question. This is consistent with the theory that naming joins the reading repertoire (Greer & Keohane, 2005).

In order to be an effective reader, an individual must be able to textually respond to the printed stimuli while simultaneously acting as a listener (combining his/her tact repertoire) to comprehend what is being read. This means that the individual must be able to acquire the names for stimuli from written text, and equate them to stimuli in the environment in order to facilitate comprehension. The speaker component of naming allows individuals to hear the name of a stimulus in the environment, and respond to that stimulus using a production response such as speaking or writing. Furthermore, in order to connect the stimuli in texts to stimuli he/she has seen in the environment, one must be able to see those stimuli within one's own skin in the

absence of the physical stimuli. This means that a strong conditioned seeing repertoire, coupled with a strong speaker repertoire, may contribute to an individual's comprehension of a text.

Experiment III sought to test the effects of a storyboard intervention, which included producing and sequencing narrative components of a story, on the comprehension of texts without pictures present. Prior to the intervention, all participants exhibited low comprehension scores for texts without pictures present, and did not have conditioned seeing in repertoire. Following the storyboard intervention, all participants exhibited increases in their comprehension scores to texts without pictures present, as well as increases in their responses to the conditioned seeing measures. Furthermore, the students who demonstrated the most significant comprehension gains without pictures present, performing above 83% on the post intervention probes, also demonstrated increases in their speaker components of naming, as well as the conditioned seeing repertoire as measured by the drawing responses.

Major Findings

The findings of Experiments I, II, and III support the hypothesis that strong production response repertoires and the behavior of seeing an image within one's own skin are important factors contributing to the accurate comprehension of texts. Conditioned seeing, or the behavior of seeing an image of a stimulus within one's own skin, allows a reader to equate the textual stimuli he or she is reading to events and objects in the environment (Skinner 1957). If a student can emit the behavior of visualizing what he or she is reading, and form a "mental picture" of the events and characters, he or she will be increasingly likely to comprehend what is being read. This type of stimulus control is essential for comprehension, and is only possible when individuals are able to equate textual and visual stimuli to one another. The presence of the naming capability connects texts to experiences and stimuli in the environment that can allow a child to visualize what is being read and learn in new way (Greer & Keohane, 2005).

Naming joins reading. Children learn information incidentally through interactions with caregivers in the environment (Greer & Longano, 2010). When a caregiver says the name of an object in the environment, while a child is attending to the object, he/she may learn the name of that object incidentally through that interaction (Greer & Longano, 2010). The behavior of equating a stimulus in the environment with the corresponding spoken word demonstrates the emergence of the naming repertoire. When children become readers, and can fluently textually respond, the words in the text join with the stimuli in the environment in a similar manner; however, these stimuli are not always present when during reading. When the stimuli are not present in the environment in the form of a picture or a physical object, the child must be able to equate the words they are reading with events and objects in the environment. The behavior of seeing a stimulus within ones own skin joins the words the child is reading with stimuli he or she has seen in the environment; resulting in conditioned seeing and the comprehension of what is being read (Skinner, 1957). Figure 18. demonstrates how naming joins reading through relations between the text, conditioned seeing, and the environment.

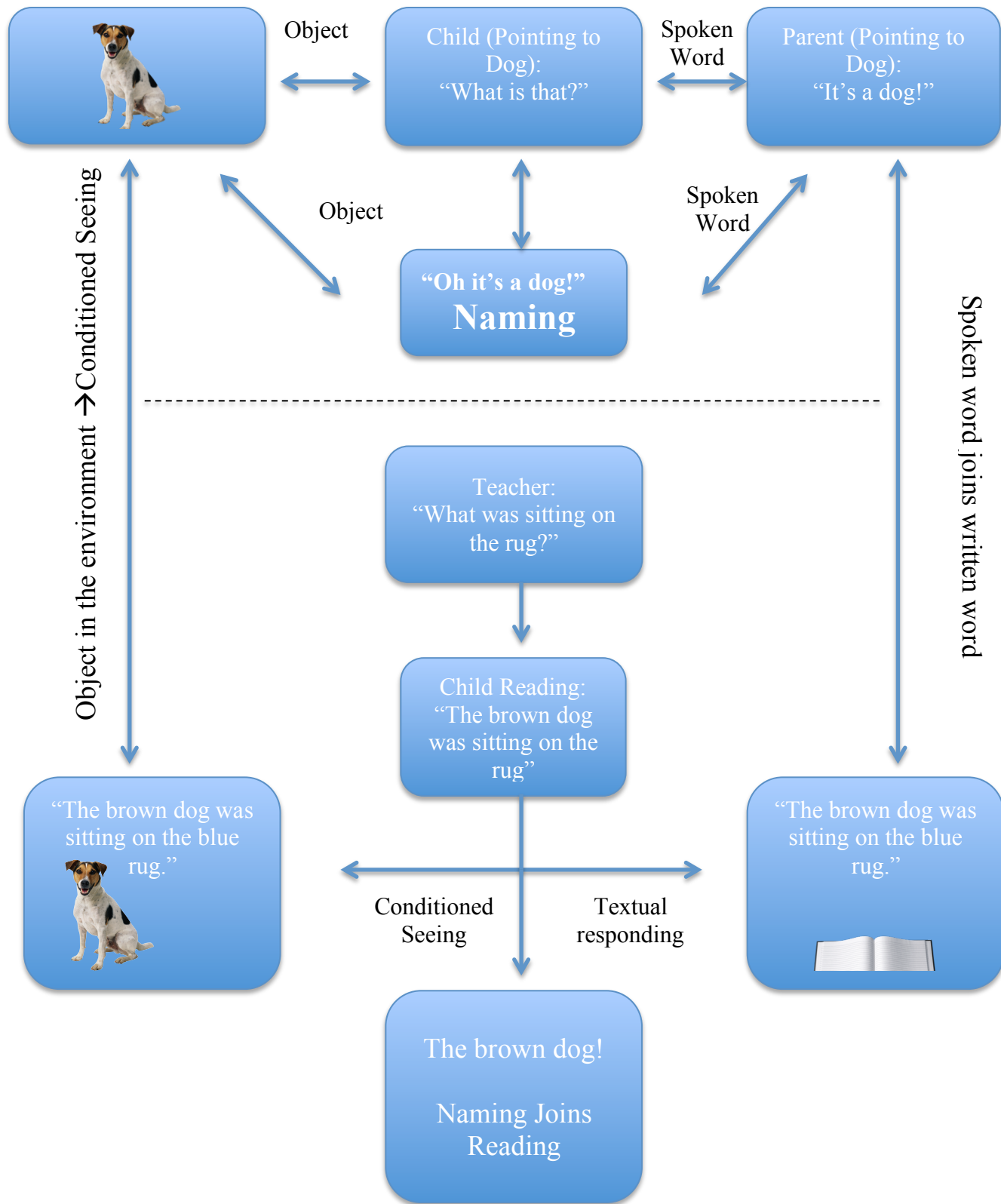


Figure 18. represents how naming joins reading comprehension through conditioned seeing.

All but one participant (Participant A), demonstrated increases in correct responses across both the speaker and listener components of naming following the intervention. It should be noted that Participant A had the lowest mean comprehension scores following the intervention, as compared to the other 5 participants, who demonstrated gains across the speaker and drawing responses. This aligns with the hypothesis that naming joins the reading repertoire, as all the participants that demonstrated increases in the speaker component of naming also demonstrated more significant increases in comprehension for texts without pictures present. Furthermore, this also aligns with the hypothesis that a poor production response repertoire (speaking, writing) may contribute to poor comprehension.

Emergence of conditioned seeing. All participants of the study exhibited increases in the percentage of comprehension questions answered correctly for stories without pictures present as well as the correct number drawing responses in the absence of the stimuli following the storyboard intervention. It could be argued that the use of the storyboard to create images that match to the narratives being read allows a stimulus relation between the text and mental images to emerge, resulting in conditioned seeing.

The intervention elicits conditioned seeing through a pairing of the stimuli on the website with the events read in the text. When the students view the stimuli on the storyboard website, they act as discriminative stimuli for recalling the events in the story. Then, the pairing of these stimuli with the events in the story creates a derived stimulus relation between the text that has been read and the images on the website to form a type of conditioned seeing. Over the course of the intervention, the storyboard stimuli are paired with the text until the relation occurs in the absence of the visual stimuli from the storyboard. When students are able to comprehend texts

in the absence of a visual stimulus at the same or better accuracy as with a visual stimulus present, it could be argued that conditioned seeing has emerged.

Selection and production of stimuli. The component of the intervention that was most directly related to the emergence of the conditioned seeing repertoire and the subsequent increases in comprehension was the large selection stimuli used to produce the sequence of the setting, characters, and props to match the narrative. From a young age, students are instructed to sequence the components of a story either with pictures or using written text. In these types of exercises, the students are given a set of detailed pictures or written story that they are required to put in sequential order (first, next, last). These types of exercises are strictly selection responses without replacement meaning that the student is only able to choose from a set number of stimuli and once a stimulus is ordered, it eliminates that stimulus as a choice for the next sequential response. This allows the students to use other higher-order problem solving repertoires to complete the sequence, instead of recall, which is necessary for summarizing a text.

However, during the storyboard intervention, the participants were required to emit production responses from a large selection of stimuli, that could be used multiple times, in order to create a storyboard that matched the components of the narrative. The selection of stimuli acted as a discriminative stimulus for the participants to recall events and characters for his/her sequential storyboard. The selection of stimuli functioned to facilitate comprehension, while still requiring the students to recall the important components of the narrative in order to create a corresponding storyboard. The addition of the production response paired with the selection responses not only facilitated increases in comprehension, but the functional learning of vocabulary as well.

Vocabulary. According to Skinner, the dictionary does not provide us with meanings for words; its contents merely function as tacts for stimuli in the environment, which can be altered and changed through various contingencies (Skinner, 1957). Yes, a definition can tell an individual what something is or what something does, but it does not provide the contingencies through which an individual can construct meaning. When Skinner discusses textual responses as related to verbal behavior, he makes a very important distinction between an individual comprehending what he or she has read and the individual merely emitting the echoics for the words printed on the paper. Until the speaker has an opportunity to emit the response under relevant environmental conditions, it is unclear as to whether or not meaning is present (Skinner, 1957). This statement highlights the notion that regurgitating information, such as reading a definition from the dictionary, may imply one of two things: 1) there is a chance that the speaker has come into contact with the relevant contingencies in the environment construct meaning, or 2) he or she is simply emitting an echoic for the definition written on the paper.

Through the storyboard intervention, the participants are learning vocabulary in context, meaning they are coming into contact with the meaning of a word within the relevant environmental contingencies to derive meaning. Seeing the word in context in the narrative, and selecting the correct stimuli to derive meaning from the word in the context of the storyboard allows for the participants to build a functional vocabulary without direct instruction. This increase in functional vocabulary through the pairing of words in context with the stimuli present in the storyboard intervention may function to increase comprehension through the expansion of the participant's vocabulary through a type of naming experience.

Limitations

Experiments 1 & 2

Experiments 1 & 2 are not without limitations. One limitation of Experiments 1 & 2 are the sample size. The total number of participants for Experiments 1 & 2 was 44 participants, which is a small sample size in comparison to other group design investigations. Furthermore, the number of students within each group varied greatly. The below grade-level group was the largest (n=19), followed by the on grade-level group (n=13), and the above grade-level group (n=12). Due to the small sample size, the results may have been skewed towards a significant correlation.

Another limitation of Experiments 1 & 2 is the number of probes administered for each of the participants. For the experiments, only one naming and one conditioned seeing probe were conducted for each of the participants. Multiple probes for both the naming and conditioned seeing repertoires may have yielded different results.

Experiment 3

Experiment 3 is not without limitations. One limitation is the number of reading probes conducted for each participant prior to the intervention. Due to the length of the reading comprehension probes, following the initial probes, the second set of pre-intervention probes was only conducted directly before the participant entered the intervention, instead of as each group entered the intervention.

Another limitation of Experiment 3 is the subjective nature of the storyboard. Due to the large number of stimuli presented on the storyboard website, during the intervention, many of the participant's depictions of the characters and scenes, although correct, look vastly different. The procedure could be streamlined to allow for a more consistent depiction of the stories by limiting the number of choices for the storyboard.

The last limitation of Experiment 3 was the termination of the intervention for Participant E. Participant E received 10 intervention sessions, with a mean score of 77.61% (Range:

61.11%-95%) correct responses during intervention sessions (Figure 11.). Following an overall ascending trend for 6 data paths, a decision was made to continue the intervention. Following three more data paths with an overall descending trend, a decision was made to terminate the intervention and conduct post intervention probes. Because Participant E did not respond at criterion level before termination of the intervention, it is unclear if he would have made additional gains in comprehension scores or acquired the naming repertoire.

Future Research

Ensuring that children are able to read at or above grade-level standards by third grade is essential for his or her success academically and professionally going forward. Due to this, it is essential to arrange instruction so that children learn to read and comprehend texts by third grade or sooner. National Reading Panel's analysis of reading instruction found that the best approaches to reading instruction are ones that incorporate explicit instruction in phonemic awareness, systematic phonics instruction, fluency practice, vocabulary, and strategies that facilitate comprehension (NICHD, 2001). With this information, coupled with the results of the present study, future research should arrange instruction so that the use of visualization strategies to induce conditioned seeing are included in reading instruction from the get-go. Therefore, a modified version of this experiment should be conducted with participants who are first learning to read. Initially, the experimenter would teach the students the object name relations for the stimuli included in the story, then the experimenter would read a story without pictures present including the target stimuli, to the participant as they follow along. Next, the participant would sequence pictures containing exemplars and non-exemplars of the stimuli in the story to increase comprehension of texts. This arrangement of instruction will allow for a pairing of the experimenters's textual responses with the words written on the page, versus the experimenter's textual responses being paired with the pictures. This will allow for joint stimulus control to

emerge for the participants between the written words and the textual responses emitted by the experimenter; creating a strong foundational reading repertoire for these participants moving forward.

Furthermore, future research should also be conducted to assess whether conditioned reinforcement for reading would emerge from completing the intervention. Due to the reinforcing nature of the intervention, it could be argued that the pairing of the highly preferred storyboard with narrative texts could condition reading similar fiction stories.

Functional Application

The results of the present study demonstrated the effectiveness of the storyboard intervention on increasing comprehension for students performing below grade-level in reading. The intervention is not only an effective tool for increasing comprehension for students, but it is also easily implemented in a single-teacher classroom. In terms of time, 75% of the time spent on the intervention requires the participant to independently read, create a storyboard, and answer comprehension questions. Only 25% of the total time spent on the intervention is teacher directed, which is approximately 10 to 20 minutes depending on the number of edits the participant must complete. Due to the independent nature of the intervention, it could easily be implemented in a “station rotation” in a classroom, where the students rotate between teacher-led instruction, partner work, and independent practice.

Not only is the intervention easily implemented, but it is also extremely motivating to the students. Throughout the course of the study, all participants were eager to engage in the intervention sessions, and complete the tasks. All participants engaged in the intervention sessions independently, and required no extrinsic reinforcement for completing tasks. Furthermore, the students were reinforced by creating storyboards that had one-to-one correspondence with the narratives they read, and were excited to receive teacher feedback.

Each of these aspects adds to the ease with which the intervention can be implemented, as well as its functional application in the classroom.

Educational Significance

Reading and comprehending texts without visual stimuli present is an essential skill for academic success from third grade forward. Instructing students to read without pictures present will allow the text to become the controlling stimulus in the comprehension of texts instead of the pictures. If we can instruct our students to attend to the words in a book from a young age, and equate them to stimuli in the environment, the easier the shift in instruction will be when pictures become less prevalent in texts.

As stated previously, being literate is a skill necessary for students to access the curriculum and information needed to be successful in an educational setting. Students are not only required to read in order to learn concepts across various disciplines such as mathematics, science, and social studies; but, disseminate and apply the information accessed to situations in the environment (Annie E. Casey Foundation, 2010). Due to this methodological shift in instruction, many students are unable to independently access the curriculum in fourth grade as a result of not having mastered the foundational reading skills necessary for this higher-level application (Annie E. Casey Foundation, 2010). These missing foundational reading skills render up to half of the printed fourth grade curriculum incomprehensible to students reading below grade-level (Annie E. Casey Foundation, 2010). By inducing conditioned seeing and the relation between mental images and textual stimuli, students will be able to comprehend what is being read regardless of the presence of visual stimuli, which in turn would increase their comprehension across academic domains.

Conclusion

In 3 experiments, I tested for 1) the presence of the naming capability and the participants' drawing responses to the stimuli learned in the absence of the visual stimulus, 2) the differences in below, on and above grade-level students' comprehension of texts with and without pictures present and its relation to the naming and drawing repertoires, and 3) the effects of sequencing and producing components of a narrative story on below grade-level participant's responses to written comprehension questions without pictures present. The present study demonstrates the effectiveness of the storyboard intervention on increasing reading comprehension repertoires for students performing below grade-level on texts without pictures present. It can be speculated that this increase in comprehension may be due to the pairing of the visual stimuli in the storyboard with the words in the story to facilitate comprehension. The results of the present investigation also demonstrate the relation between a strong production response repertoire and reading comprehension repertoires, showing that a student must be able to use the information he or she is reading about in a speaker function in order to comprehend a text. Furthermore, the results of the present study also demonstrated the effectiveness of the storyboard intervention on increasing the conditioned seeing repertoire for all students. The use of the storyboard to create images that match to the narratives being read allows for a stimulus relation between the text and mental images to emerge, resulting in conditioned seeing; which in turn, increases comprehension. Allowing our instruction to set the occasion for the emergence of conditioned seeing, by pairing the behavior of seeing a stimulus within one's own skin with reading, we can increase reading comprehension, and in turn increase educational outcomes for our students.

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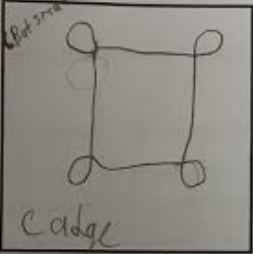
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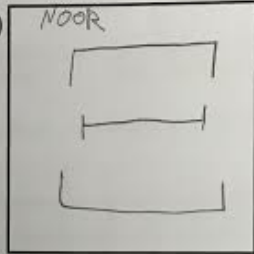
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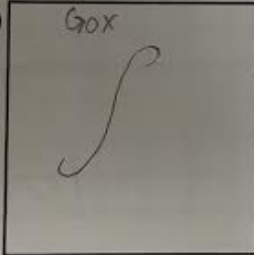
Appendix A


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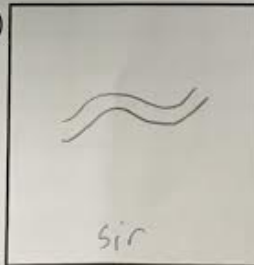
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edge

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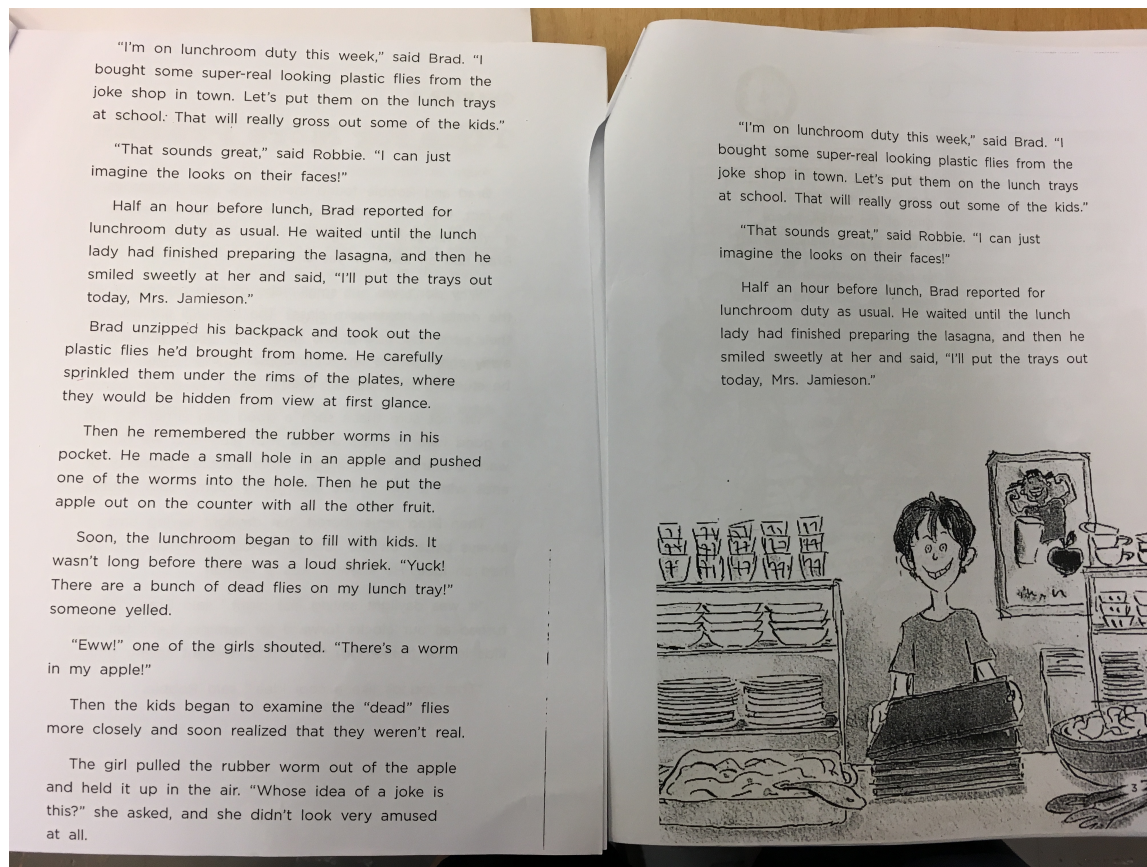
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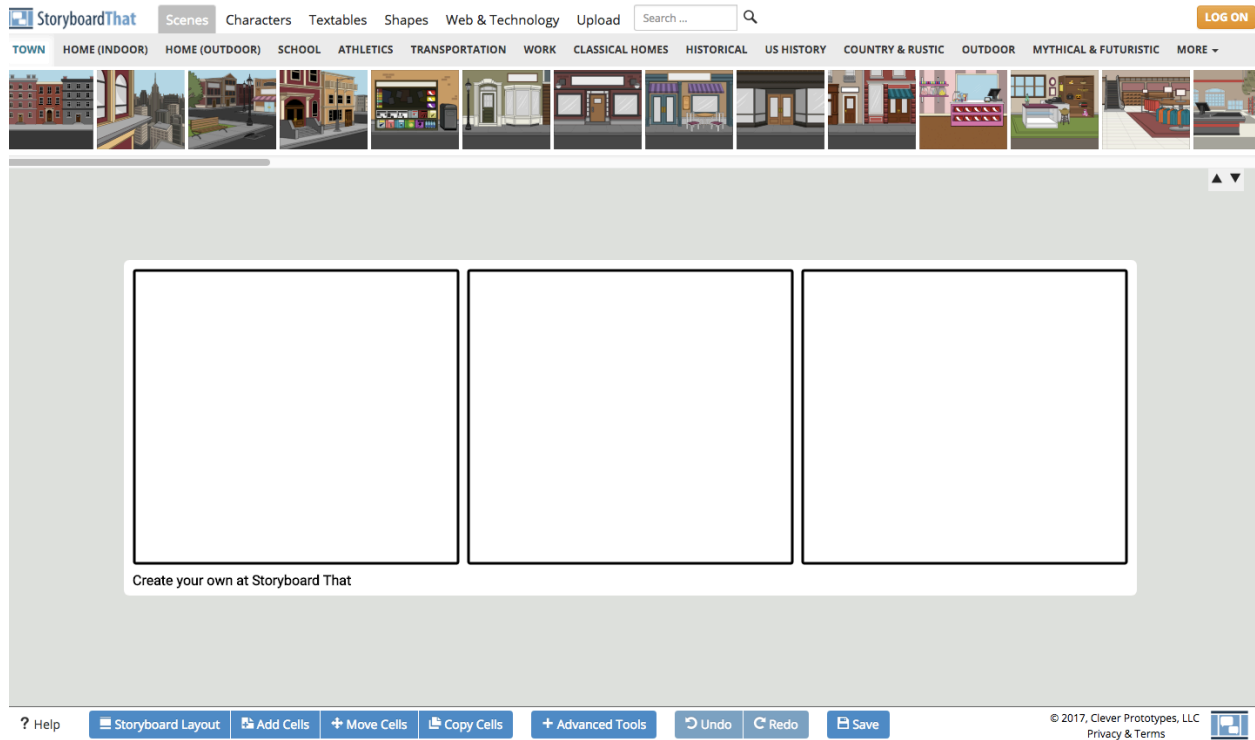
This is a drawing response form completed by a participant.

Appendix B



These are examples of the same story with and without pictures present. The image on the left is the story without pictures, and the image on the right is the same story with pictures present.

Appendix C



An example of the tools on the storyboard website utilized by the participants during the intervention.

Appendix D

The Impossible Pet Show

My best friend Carla called me on Thursday afternoon. "Daniel, meet me in the park in five minutes. I have a great idea!" This worried me because Carla's great ideas almost always ended in trouble for me!

I dashed outside and jogged to the park. When I saw Carla, my heart sank because her gigantic dog Rover was with her. He was a black fluffy dog. I liked everything about Carla except Rover. I've never had a pet, so I feel uncomfortable and nervous around animals. I'm embarrassed to say that I'm afraid of Carla's dog.

Carla smiled. "Isn't this the perfect location for a pet show?" she asked. "All the kids in the neighborhood can show off their pets' talents and demonstrate the things they do well. There are plenty of comfortable benches for our parents and friends to sit on. And since you don't have a pet to enter into the show, you will be the announcer." "I'm sorry," I apologized, "but that's impossible! Crowds make me nervous, besides I don't like animals, remember?"

"That's nonsense," said Carla. "There's nothing to be concerned about because you'll be great!"

Just then, Rover leaped up and slobbered all over me, and almost knocked me down. "Yuck. Down, Rover! Stay!" I shouted. Rover sat as still

as a statue. "Wow, you're good at that," said Carla. "Now lets get started because we have a lot to do."

By Saturday morning I had practiced announcing each pet's act a hundred times. My stomach was doing filp flops by the time the audience arrived. The size of the crowd made me feel more anxious.

When the show began, I cleared my throat and announced the first pet. It was a parrot named Butter whose talent was walking back and forth on a wire. When Butter finished, everyone clapped and cheered. So far, everything was perfect and I was beginning to feel calmer and more relaxed. I realized that being an announcer was not so bad after all.

Then it was Carla and Rover's turn.

"Sit Rover," She said, but Rover didn't sit.

Rover was not paying attention to Carla. He was too interested in watching the bunnies jump in and out of their boxes. Suddenly, Rover leaped at the bunnies that hopped towards Mandy. All of the animals began going crazy.

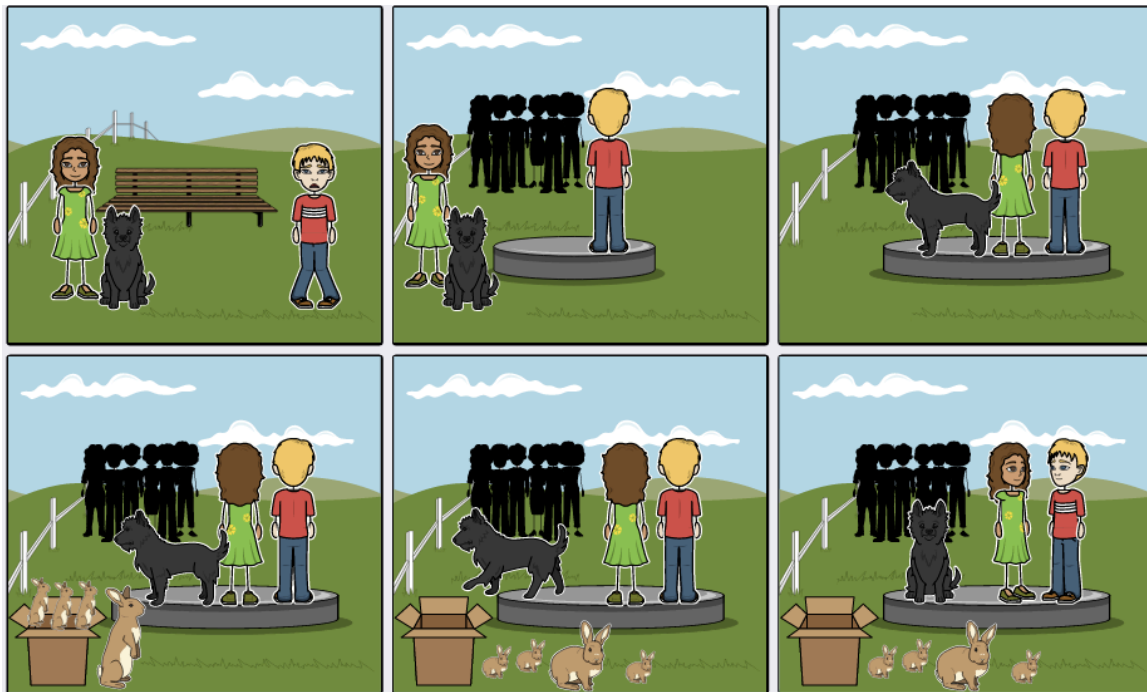
"Sit!" I shouted at Rover. "Quiet!" I ordered the other animals. "Stay!" I yelled. Everyone-kids and pets-stopped and stared at me. Even the audience froze.

"Daniel, that was incredible," said Carla. "You got the pets to settle down. That's quite an achievement."

Sadly, that was the end of our pet show, but now I have more confidence when I speak in front of people. And even through I am still nervous around animals; Rover and I are great friends.

Example of a narrative used to for the intervention sesssions.

Appendix E



Examples of storyboards created by the participants to match the components of the story “Impossible Pet Show”.

Appendix F

1. ✓ What were Anthony and Spike playing with?

A ball outside ✓

2. ✓ What distracted Anthony?

Lunch time

3. ✓ What happened to Spike?

he got lost

4/ How did Anthony feel when Spike was lost?

Very sad

5/ What are three places Anthony looked for Spike?

At there neighbors the
park and the carnival

6/ What did Anthony hear that gave him an idea?

The carnival

7/ Where did Anthony last look for Spike?

The carnival

8/ What was Spike doing when Anthony found him?

he was in the carnival
he had a potesle in his mouth.

9/ What did Anthony do after he found Spike?

They spent the rest of the at
the carnival

Example of the comprehension question set for story "Where is Spike" with reinforcement and correction provided by the experimenter.

Appendix G

Bear Scare 1. Where was John excited to go? 2. What bunk did John choose? 3. What did John look like? 4. Where did the kids go that night? 5. What were they eating? 6. How did John solve the problem? 7. After the scare, what did the kids roast at campfires? 8. What did John teach the other kids? 9. Why were the other kids happy to have John around?	Jesse & the Cat 1. What was wrong when Jesse got home? 2. What is the name of Jesse's cat? 3. What does the cat look like? 4. Who does dad call to help solve the problem? 5. What does Jesse get to solve the problem? 6. How do Jesse and her dad solve the problem? 7. Where does the cat end up? 8. What does Jesse say to her dad at the end of the story? 9. Where do Jesse and her dad go when the problem is solved?	The Soccer Game 1. What do Samantha and Jennifer look like? 2. What soccer team are Jennifer and Samantha always on? 3. What matching clothing did the girls always buy? 4. What happened at soccer tryouts? 5. What teams played in the championship? 6. What happened in the final minute of the game? 7. What was Jennifer thinking about during that final minute? 8. What did Samantha say to Jennifer after the game? 9. Where did the girls go when the game was over?	The Spring Dance 1. Why was Stacy upset? 2. What did Michelle say to make Stacy feel better? 3. Why did Stacy still not want to go to the dance? 4. Why did she decide to go to the dance? 5. What colors were Stacy & Michelle's dresses? 6. What did the principal announce at the dance? 7. How did Stacy feel at the end of the dance? 8. What did Stacy's crown look like? 9. What did the girls do at the end of the night? 10. What did Stacy do when she got home?	Where is Spike? 1. What were Anthony and Spike playing with? 2. What distracted Anthony? 3. What happened to Spike? 4. How did Anthony feel when Spike was lost? 5. What are three places Anthony looked for Spike? 6. What did Anthony hear that gave him an idea? 7. Where did Anthony last look for Spike? 8. What was Spike doing when Anthony found him? 9. What did Anthony do after he found Spike?
The Impossible Pet Show 1. Where did Carla tell Daniel to meet her? 2. How does Daniel feel around animals? 3. What is Carla's idea? 4. What does Carla want Daniel to do? 5. How does Daniel feel about it? 6. How does Daniel feel before he starts the show? 7. What happens when Rover and Carla are performing? 8. How does Daniel save the day? 9. How does Daniel feel when he speaks in front of people now? 10. How does Daniel feel about Rover at the end of the story?	Prince Jacob 1. Why are the towns people jealous of Jacob? 2. What did Jacob have a lot of? 3. What is the first thing Jacob wants his servant to replace? 4. How does he feel after his servant replaces it? 5. What is the second thing he wants his servant to replace? 6. How does Jacob feel after his servant replaces it? 7. Where does Jacob go when he leaves the castle? 8. What place does Jacob find? 9. What surprises Jacob? 10. What does Jacob realize makes him happy?	The Big Blizzard 1. Why was everyone stuck inside? 2. Why weren't the kids allowed to go out? 3. Why was Rosa worried? 4. Why did Mama need to go out? 5. What did Rosa and Eddie need to do before they went outside? 6. What did Rosa and Eddie see when they went outside? 7. How did they help Mr. Colon? 8. Why did Mrs. Sanchez need help? 9. What did Mrs. Sanchez give to Mama to say thank you? 10. What do they hear when they are walking back across the street? Who is it?	Mystery at the Mays 1. What was Zoe missing when she woke up in the morning? 2. Why did Zoe need to find it? 3. The next day, what does Zoe lose? 4. Why is Zoe's brother calling her? 5. Why does Sam need to find it? 6. Who comes to the house? 7. Why is she coming over? 8. Who was missing? 9. Where did they find her? 10. What did they do at the end of the story?	Missing Sneakers 1. Why is Sarah packing her stuff? 2. What does Sarah's mom tell her to do? 3. What was the noise Sarah hears downstairs? 4. When Sarah gets upstairs, what does she notice? 5. Where does Sarah first look for Sneakers? 6. When Sarah goes outside, where does she look for Sneakers? 7. What does Sarah hear coming from the moving truck? 8. Where does she look? 9. What does she find? 10. What do they do at the end of the story?

Comprehension questions sets for intervention sessions.

Appendix H

BEAR Components	A	B	C	D	E	F
John						
Mom						
Dad						
Steve						
Counselor						
Kids						
Home						
Camp						
Bear						
Marshmallows						
Chicken Legs						
Total						

Spring Dance Components	A	B	C	D	E	F
Stacy						
Michelle						
Classroom						
Home/School						
Dance						
Silver Crown						
Principal						
Pink Dress						
Blue Dress						
Total						

Plot Area

Example of the data sheet used to score the storyboards created by the participants to match the components of the story during the intervention.